5-2011

Critical Thinking Skills as Related to University Students Gender and Academic Discipline.

Brent Tyler Leach
East Tennessee State University

Critical Thinking Skills as Related to University Students' Gender and Academic Discipline

---

A dissertation

presented to

the faculty of the department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctorate of Education

---

by

Brent Tyler Leach

May 2011

Dr. Donald Good, Chair

Dr. Cecil Blankenship

Dr. James Lampley

Dr. Pamela Scott

Key Words: California Critical Thinking Skills Test, Constructivism, Critical Thinking, Gender

ABSTRACT

Critical Thinking Skills as Related to University Students' Gender and Academic Discipline

by

Brent Tyler Leach

For a number of years the educational community has recognized the importance of teaching critical thinking skills to all students; however, a shift in educational pedagogy and philosophy has occurred. Through recent legislation the funding of educational institutions that demonstrate competencies and gains from standardized test scores has been mandated. Although performance measurement regarding the effectiveness of learning environments is useful, students must learn critical thinking skills to compete globally, problem solve effectively, self-actualize, preserve democracy, and promote human rights. The relationship between content and critical thinking presents a unique challenge in American education. This study examined the shift in focus from critical thinking to standards-based assessment in American education and focused on data garnered and analyzed from The California Critical Thinking Skills Test (CCTST).

The purpose of this study was to determine if there were differences in the 5 dimensions of critical thinking based on colleges and gender based upon 1,455 graduating seniors for the 2009-2010 academic year on the (CCTST). This study used descriptive and inferential statistics to analyze data.

In this quantitative study, data from the (CCTST) were gathered and distributed to the researcher for compilation and statistical analysis. Findings from this study indicate that gender and major

college of study significantly influence the means on the dimensions of the CCTST. This study provides information regarding critical thinking skills in a higher education setting and is useful for higher education practitioners in facilitating the development of critical thinking skills. The results of this study add to the body of knowledge regarding critical thinking.

DEDICATION

This work is dedicated to my loving wife, devoted sons, exemplary extended family, and courageous mom. Without their never ending support and encouragement this dream would not have been achieved. Thanks for loving me through this journey.

ACKNOWLEDGEMENTS

I sincerely appreciate the assistance of my committee chair, Dr. Donald Good. Thank you for being so agreeable to take my project on and provide much needed guidance. Committee members, Dr. Pamela Scott, Dr. James Lampley, and Dr. Cecil Blankenship are very much appreciated for their support and assistance. A special thanks to Dr. Lampley for his direction in the choosing of this research project and getting me off to a good start. Additionally, a special thanks to the College of Education, particularly Dr. Patricia Robertson and the entire Human Development and Learning family for the opportunity to learn and grow personally and professionally while completing this project.

A special thanks to Dr. Kathy Jo Yates for her expertise, assistance, and persistence with the completion of this project. I am blessed to know you and be coached by you.

CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

The educational system in the United States has experienced a major shift within the last 30 years. This shift reflected a change from the intent of the early progressivists who focused on critical thinking to an essentialist approach that focused on core-content memorization and recitation (Sadker & Sadker, 2003). Present legislation including but not limited to the No Child Left Behind Act of 2001 demands the accountability of public school systems, typically measured by outcome-based assessments in the form of standardized testing.

The philosophy of progressivism as espoused by John Dewey promoted the practice of critical thinking through a reflective experience enhanced by teacher-pupil discussion (Slavin, 2009). The philosophy of essentialism, prevalent in American education, is evident by the demand to follow set curricula focused on specific and measurable academic standards (Slavin, 2009).

Although the teaching of critical thinking skills was determined to be a goal for American education by The National Educational Goals 2000, the push to promote standardized testing with a consequent move from progressivism to essentialism has moved the focus on critical thinking from a national priority to an objective of much lesser importance (Sadker & Sadker, 2003). The report, A Nation at Risk, (National Commission on Excellence in Education, 1983) initiated educational reform that emphasized accountability through standardized testing. This reform has led school educators and schools to be evaluated on the test score gains demonstrated by measuring content knowledge; consequently the teaching of critical thinking skills has become a low priority.

The balance of *testing* what a student knows and *determining* what a student knows is a complex process. The emphasis on obtaining high scores from standardized testing impedes this balance (Marzano, 2007), and funding for public education is directly related to gains from standardized test scores. Although gains in test scores may be important information regarding the effectiveness of a learning environment, students must learn critical thinking skills in order to view the world accurately, to become lifelong learners and competent problem solvers, and to contribute to a highly skilled workforce capable of competing within the global market (Trottier, 2009).

The relationship between content and critical thinking presents a unique challenge in American education. Instructional requirements emphasizing the mastery of academic standards of learning mandated by the No Child Left Behind Act make it difficult if not impossible to focus instruction on teaching critical thinking skills. Federal and state funding as well as the rehiring of instructors is tied to the successful mastery of academic requirements addressed in the legislation. Matheny (2009) stated that public school educators become so overly focused on students passing specific academic standards that many teach to the test itself.

Matheny (2009) discussed the debate between educators and government by addressing the emphasis of critical thinking in the classroom. Matheny suggested there is a fear from educators that an overemphasis of critical thinking skills will affect core content memorization. According to Willingham (2009), however, the development of critical thinking skills improves content memorization and retrieval. Critical thinking skills must be carefully examined to determine the effect on core content knowledge. It must be determined if critical thinking is a helpful tool and if it is appropriate in most settings. Matheny proposed that critical thinking skills and core content acquisition support each other and the idea of choosing between the two is a

false dichotomy. Matheny further emphasized that instruction in critical thinking and core content are designed to be delivered simultaneously.

Critical thinking is a skill that should be taught early, practiced often, and should not be pushed from core content designs (Trottier, 2009). Students appear to be better critics than critical thinkers from evidence that looks at student reactions to skepticism and developing personal points of view (Trottier, 2009). The acquisition of content typically requires choosing whether a concept is true and then applying that truth to a given situation. Critical thinking goes beyond and requires evaluating, questioning, and synthesizing new information. Knodt (2009) stated that students have a natural curiosity to explore content beyond a lower level of rote knowledge to a more complex higher-level of thinking that analyzes and evaluates.

Knodt (2009) stated that innovative thinking is enhanced when the natural inquisitiveness students bring to the learning process is inspired, affirmed, and cultivated. When given the opportunity to ask and explore openly, students learn and thrive. This opportunity must be provided by the educator if students are to learn to be critical thinkers rather than critics. Opportunities must be provided for students to voice opinions and objections to topics rather than seek right or wrong answers. This brainstorming process is necessary to fuel the continuing curiosity of the learner. Content knowledge is best taught using natural curiosity because there is an innate desire within everyone to learn by challenging thinking (Healy, 1990). Critical thinking, higher order thinking, and problem solving make learning motivating, energizing, and fun (Jensen, 2005).

When critical thinking skills are omitted from the educational process, society misses tremendous benefits (Jenkins, 2009). Jenkins shared that students who lack critical thinking skills and teachers who do not teach them inhibit students' ability to think. He stated that the

cognitive demands that come from being challenged to think in new and unfamiliar ways are invaluable to intellectual development. Tsui (2002) shared that critical thinking skills challenge what is typically assumed by others and encourages students to recognize the importance of different perspectives in problem solving.

Statement of the Problem

Because of a shift in focus from critical thinking to standards-based assessment in American education, this study analyzed the data from The California Critical Thinking Skills Test (CCTST) administered to seniors at a university in the southeastern section of the United States. The instrument used in this study delineates five dimensions of critical thinking. This study provides information regarding the need to develop critical thinking skills in an educational environment that emphasizes "one size fits all" standardized testing. The purpose of this study was to investigate the relationship of the five dimensions of critical thinking as measured by the CCTST as related to gender and academic discipline within a university setting.

Research Question

Through quantitative analysis of the CCTST administered to graduating seniors at the selected university, this study investigated the relationship of gender among the five dimensions of the instrument. The following research question was addressed:

> Is there a significant difference in mean scores for male and female students and the six major academic colleges on the five dimensions of the CCTST that include analysis, deduction, evaluation, induction, and inference?

Significance of the Study

Results, relative to the variable of gender, from the CCTST have not been analyzed to a great extent. This study analyzed the data of graduating seniors to determine the effect of gender among the five dimensions that include: analysis, deduction, evaluation, induction, and inference. This research was conducted to explore the relationship of gender to the five areas of critical thinking among the six major academic colleges at a university in the southeast United States. This study was designed to add to the body of research in the area of critical thinking and to offer new information regarding the relationship among critical thinking, gender, and academic discipline.

Limitations and Delimitations

This study involved graduating seniors at a university in the southeast United States. It is a university with a 2009-2010 student enrollment of 13,500 where 80% of students are commuters, and 80% are Caucasian. The results of the study are not necessarily generalizable to other college settings that may have dissimilar demographics. The CCTST scores are limited to graduating seniors at this university and may not be generalized to other institutions of higher education. The limitation for the study was the motivation of the students to communicate accurately their levels of critical thinking through a standardized test.

Definition of Terms

The following terms are defined for use in this study:

1. *California Critical Thinking Skills Test (CCTS)*- An instrument for data collection that measures critical thinking dimensions of analysis, deduction, evaluation, induction, and inference (Facione, 1990).
2. *Constructivism*- The knowledge constructed from the perceptions, experiences, and mental representations of the learner (Slavin, 2009).
3. *Critical Thinking*-The evaluation of thorough logical and systematic examination of the problem, the evidence, and the solution (Slavin, 2009).
4. *Essentialism*- The initiative lies with the instructor rather than the pupil and involves hard work and often unwilling application (Sadker & Sadker, 2003).
5. *Problem Solving*- The application of knowledge and skills to achieve certain goals (Slavin, 2009).
6. *Progressivism*- The ability to learn through problem solving as opposed to inculcating subject matter characterized by free interplay of ideas and personalities necessary for growth (Sadker & Sadker, 2003)
7. *Standardized Testing*- Examinations administered and scored in a predetermined manner (Slavin, 2009).

Overview of the Study

This quantitative study is presented in five related chapters. Chapter 1 consists of an introduction to critical thinking, the statement of the problem, the significance of the study, the research questions, the limitations and delimitations of the study, the definition of the terms, and the overview of the study. Chapter 2 is a review of related literature that approaches topics that influence educational practice and reform. Chapter 3 is a description of the methods and procedures used in the study. Chapter 4 is a description and presentation of the data related to the research question. Chapter 5 is a summary of findings for the study, recommendations for practice, and recommendations for further research.

CHAPTER 2

REVIEW OF THE LITERATURE

For the purpose of this study several areas of critical thinking were identified and addressed. The literature review consisted of the development of critical thinking skills, early educational theorists, contemporary practitioners, moral reasoning, improving critical thinking skills in higher education, negative influences of standardized testing, additional barriers to critical thinking, constructivism, stages of critical thinking, and critical thinking and gender.

The Development of Critical Thinking Skills

Although the importance of teaching critical thinking skills in American schools has often been debated, the research indicates that critical thinking must be an integral component in all educational settings (Elder & Paul, 2009). In order to compete globally students must graduate from high school or college with the ability to problem solve and use critical thinking skills (Law & Kaufhold, 2009). Employers are looking for a work force that can think critically and produce results (Law & Kaufhold, 2009). Information regarding the preparation of critical thinking for college graduates, therefore, is necessary. Kirkwood (2003) shared the importance of critical thinking skills among college students to prepare for life and in advocating for self and social causes. Healy (1990) stated that critical minds are a society's most valuable natural resource worthy of the effort and time needed to cultivate.

The National Council for Excellence in Critical Thinking Instruction was organized in 1995 to address the need of critical thinking in education. The council defined critical thinking as the intellectually disciplined process of actively and skillfully conceptualizing, applying,

analyzing, synthesizing, or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Paul & Nosich, 1991). The council has continued to be a leading resource for the teaching of critical thinking in the United States.

Early Educational Theorists

The development of critical thinking skills is eclectic, having roots in education, philosophy, and psychology (Bensley, 2008). Many of the definitions of critical thinking skills are influenced by the work of early psychologists who determined the development of critical thinking required careful educational experiences. One common thread among theorists is that the acquisition of critical thinking skills is achievable in its entirety only by a higher level of thought that comes with cognitive development and maturity (Paul & Nosich, 1991).

Various authorities have debated the topic of when to introduce critical thinking in the classroom. Some educational theorists suggest that critical thinking should be implemented early; yet most educational theorists agree that the brain is most ready for the challenge of critical thinking during late childhood and adolescence (Healy, 1990; Wadsworth, 1971). The work of Piaget (1952) and Vygotsky (1986) was built around the need to develop formal operational thought or critical thinking skills beginning in late childhood and maturing throughout adolescence and adulthood.

The preeminent educational theorists of the last century, Jean Piaget and Lev Vygotsky, provided valuable early research regarding the significance of critical thinking. Piaget, a highly influential psychologist, first submitted the ideas of what have come to be recognized as the cognitive development process (Slavin, 2009). Piaget created divisions of cognitive development

identified as sensorimotor, preoperational, concrete operational and formal operational. According to Piaget (1952) the sensorimotor stage is within the age range of birth through 2 years of age. This stage primarily consists of the ability to create object permanence. From ages 2 through 7, the preoperational stage, the child is able to administer symbols to represent other objects in the world. Thinking however, remains "egocentric." The concrete operational stage follows at approximate ages of 7 through 11. During this stage a child moves to a more non-centered thinking style. The child is able to apply logic to thinking. The final stage, formal operational, typically occurs at age 11 and ensues throughout adulthood. In this stage complete abstract thinking is achievable. This stage of reasoning is necessary for higher-level thinking to occur and is the developmental prerequisite of critical thinking. Vygotsky (1986) reasoned that necessary neurological development or maturity is necessary to demonstrate critical thinking. Halpern (2007) agreed that critical thinking requires cognitive developmental maturity and the process is quite complex.

Vygotsky (1986) surmised that Piaget was missing certain elements within his construct of cognitive thinking. He stated that outside influences such as human or cultural mediators were not present in Piaget's theory of cognitive development. Vygotsky added that certain elements or building blocks of critical thinking skills were necessary for cognitive development and include the role of teacher as mentor in developing those skills. Vygotsky contradicted Piaget and states these elements are vehicles that drive development in life rather than stages through which the person passes.

Vygotsky (1986) theorized that the elements of private speech, zone of proximal development, and scaffolding encourage critical thinking skills. Private speech is defined as self-talk, which guides thinking and action and is eventually internalized as silent inner speech or

metacognition (Slavin, 2009). Private speech is the ability to think in quiet reflection, to think about thinking (metacognition), a skill that is a prerequisite for critical thinking. Vygotsky advocated the necessity of providing support to the learner presented with new information. The term "zone of proximal development" implies the necessity of teacher-led support to learners acquiring new skills or thinking (Slavin, 2009). Teacher support may be provided in various forms including presenting a problem, facilitating discussion and questioning, and providing resources necessary to acquire new thinking. With an understanding of what is necessary for higher level thinking, the ability to use scaffolding and develop abstract thought in the formal operational stage, critical thinking may be better defined. Scaffolding is any activity that enables students to solve problems independently. Examples of scaffolding include clues, reminders, and encouragement (Slavin, 2009). Scaffolding is a necessary building block for developing critical thinking skills.

Contemporary Practitioners

Slavin (2009) stated that the development of critical thinking skills requires that a teacher be an effective "intentional teacher" who is thoughtful, reflective, and prepared. According to Slavin the ideal teacher incorporates critical thinking into content delivery.

The development of critical thinking skills requires that both teacher and student evaluate information, analyze feelings, incorporate intuition, and make necessary adjustments (Brookfield, 2006). Through reflection, Brookfield emphasized that critical thinkers construct and deconstruct their own experiences and meaning. Reflection requires the thinker to evaluate information, feelings, and intuition together to make necessary adjustments in thinking. Tsui (2002) implied that critical thinking requires the thinker to suspend judgment and reflect on the

validity of a hypothesis. The development of critical thinking skills requires that the learner challenge what is typically assumed and seek to understand difficult concepts.

Through the process of organizing critical thinking workshops, Black (2005) stated that teacher training in critical thinking skills is necessary because teachers too often allow students to employ random and undisciplined thought. She stated that while many schools understand the importance of critical thinking centered at the heart of the curriculum, it is often characterized by a feeble attempt to add critical thinking questions or thinking skills to lesson plans without integrating these skills within the lesson itself. She stated that valuable critical instruction begins with a clearly stated goal that allows students to be able to reason through school subjects rather than be drilled on content memorization. Black emphasized that memorizing facts does not ensure learning that is useful over a lifetime.

Black (2005) suggested that after presenting necessary content and providing materials to support new learning, the instructor should function as a facilitator, record-keeper, and a classroom resource. As such, the teacher encourages students to explore or discover whatever concept is predetermined to be discovered. Black indicated that this process enables students to be engaged in the learning process. By assuming this role, the classroom becomes a lively and engaging learning environment (Black, 2005).

Gunn, Grigg, and Pohamac (2008) articulated that in order to meet the need for intellectual challenge the educator must provide problem solving, critical thinking, presentation of relevant projects, and complex activities to stimulate motivation and learning. Jensen (2005) shared that learning is increased when it is relevant and related to the student's personal life. Learning is meaningful when it is connected to life stages, love, health, family, current events, and personal experience: and information is irrelevant when it is impersonal, useless, out of

context, and only used to pass tests. Learning is engaging when it is emotional, energetic, active, and dependent on learner imposed deadlines and peer pressure rather than from the instructor. Students exhibit apathy and resentment when learning is inactive, disconnected from the real world, characterized by low interaction, teacher lecture, and seatwork (Jensen, 2005).

DeVoogd (2006) argued that students need the ability to question everything, and students should never take content at face value without careful analysis. For example, in describing his experiences growing up in the post-World War II era, DeVoogd stated he was indoctrinated that the United States was winning the Vietnam War as part of the conventional reasoning within his culture. As he matured, he determined, through questioning, that this belief was far from true. DeVoogd added that his mother, a youth in Germany during World War II, never heard about the holocaust until the war was over. She had been led to believe that Germany was winning the war. This mindless acceptance of propaganda perpetuated through conventional thinking leads to deception and ignorance. DeVoogd's early experiences were devoid of critical thinking, and this lack of understanding made critical thinking important to him as a teacher concerned about the thinking of others and the growth of democratic thinking within the culture. Critical thinkers recognize the importance of different perspectives in problem solving and the danger of accepting information without question (Tsui, 2002).

DeVoogd (2006) shared that teaching and allowing students to second guess everything they read or hear is controversial but holds to the fact that this encouragement is necessary in order to teach them to be analytical thinkers. He stated that students need to realize that even textbooks are written with a bias because what is written is based upon an author's values and unique version of the truth. He gives an example from the colonial period, widely viewed as a successful time in American history, with the establishment of democracy, but he pointed out

that many historians omit the Native American experience and ignore the slaughter of many in the establishment of a Eurocentric government.

The foundation of critical thinking should be presented at an early age, although developmental psychologists recognize that a student's receptivity for higher order thinking is varied (Piaget, 1952). DeVoogd (2006) gave an example of early instruction in critical thinking with his own class instruction. DeVoogd instructed students to read a story regarding working conditions of farm animals. After a period of analytical thought, the students realize the farm animals represent humans and the farmer represents the person in authority. After discussion, the students realize that the author has a bias toward the workers in order to make a particular point. DeVoogd concludes that educators must encourage this skeptical type of thought so that students will be able to analyze, evaluate, criticize, and question the world around them. The result is an informed populace that is not easily influenced or persuaded by a dominant belief system that may be incorrect or corrupt (DeVoogd, 2006).

Moral Reasoning

As young learners reach adulthood, critical thinking provides the framework for the development of a belief system. Kohlberg (1963) espoused that higher level moral reasoning should move beyond the conventional thinking that is shaped by culture. The lack of critical thinking skills limits learners to a preconventional level of thinking that is typical for young learners. Rewards or recognition for doing well on content-oriented tests is a type of lower level thinking that needs to be limited and converted to a higher level of thinking. Educators should encourage students to explore many possible conclusions rather than to encourage a single correct answer.

Conventional reasoning is a belief system and a thought process based upon what others hold as true without concern for exceptions (Kohlberg, 1963). Conventional reasoning is dictated by the status quo, majority, or dominating force and often gives rise to prejudice and discrimination.

Critical thinking allows for moral reasoning based on what is true to a personal experience and personal belief system. To think critically is to examine a belief then analyze it to determine whether the result is for self-centered personal gain or to better the situation of others (Kohlberg 1963). The result yields a spirit of insight through facilitative instruction aimed at creating a group of learners able to criticize and shape the world around them positively (Clabaugh, 2008). Students who demonstrate higher level thinking skills may be viewed as threatening when they challenge status quo thinking regarding religion, governmental policies, education, and social norms (Clabaugh, 2008). Although critical thinking skills can benefit the workplace by creating a more creative, productive, and efficient environment, concerns arise that students may enter adulthood with dangerous, nonconformist thinking. Claubaugh stated this is not always acceptable to the greater part of society.

Despite the fact that the development of critical thinking skills used in postconventional reasoning is a challenge, it is a necessary element to improve society. Clabaugh (2008) stated that the confrontation of traditional thinking disturbs the status quo. For example, questioning topics such as whether the American Revolution was actually necessary might enrage most Americans but is the risk taken with critical thinking and postconventional thought.

Clabaugh (2008) reasoned one reason critical thinking is not taught effectively in schools is to discourage rebellion and dissent. He stated that critical thinkers ask too many questions, challenge established authority, and display a tendency to invent their own rules. He shared that

school authorities acknowledge the importance of critical thinking skills but limit the development in order to maintain socialization and conformity. Kohlberg (1963) stated that reasoning skills become stagnate when debate and opinion are not encouraged. Socialization is deeply rooted in the educational system, and according to Clabaugh (2008) socialization is largely an uncritical, nonreflective process.

The difficulty lies in the need for teachers to teach both socialization and critical thinking. In the view of Clabaugh (2008) the two appear to be diametrically opposed. By teaching meaningful critical thinking teachers help to foster socialization that exhibits postconventional moral reasoning (Kohlberg, 1963). Postconventional moral reasoning enables problem solvers and critical thinkers who take ownership of their own belief systems to create a culture of justice without prejudice and discrimination. This viewpoint is demonstrated by the components of effective critical thinking: reflection, analysis, problem solving, and postconventional thinking.

Improving Critical Thinking Skills in Higher Education

The beginning of the 21st century saw the reauthorization of the Higher Education Act. The act placed increased accountability upon higher education institutions to examine and analyze graduation rates, retention, and student engagement. Higher education institutions in the United States have traditionally protected their autonomy from accountability with the understanding that learning and investigation require freedom from intellectually limiting external intervention and control (Dunwoody & Frank, 1995). Historically higher education has held fast to the philosophy that educators, not politicians, should be the driving force in

educating students (Bok, 2006). In recent years legislation has been enacted that ties funding to accountability at the higher education level (Dunwoody & Frank, 1995).

Dunwoody and Frank (1995) provided five typical reasons for student withdrawal from institutions of higher education. These include (a) dissatisfaction with grades, (b) lack of understanding content, (c) disinterest in the course, (d) dislike of the instructor, and (e) the course did not capture the student's attention. Tinto (1993) reported that student withdrawal from higher education institutions was primarily due to a lack of student engagement in learning activities with little socialization. Both researchers conclude that student engagement is enhanced by meaningful learning experiences that are marked by interaction and dialogue.

The national report, A Nation at Risk, (National Commission on Excellence, 1983) caused panic concerning educational reform that emphasized accountability through standardized testing (Brookfield, 2006). Since that time it has been reported that the failure to teach higher order thinking skills is a continuing weakness in educational system of the United States (Brookfield, 2006). Effort has ensued nationally to remedy this weakness, and the teaching of critical thinking skills was included in the U. S. National Education Goals Report of 2000 (Department of Education National Educational Goals 2000 Panel, 1992).

Bok (2006) indicated that what colleges view as important in regard to critical thinking does not always correspond to real-life situations. They considered the challenge of teaching critically in a traditional educational setting and found that these settings do not typically provide appropriate ways to encourage critical thinking. Bloom (1974) articulated the need to address higher level thinking skills to promote learning. He used a continuum from lower to higher order thinking skills. In spite of the need to promote critical thinking skills in all realms of education, the delivery of instruction is primarily within a lower level of thinking according to Bloom's

taxonomy (Elder & Paul, 2009). Bok (2006) reported that critical thinking is of utmost importance in the higher education setting with 90% of instructors polled agreeing that it is the most important component of undergraduate education.

It is increasingly important to use critical thinking skills in the present Information Age (Paul, 1993). New information is produced at a more rapid rate than ever before, and it must be analyzed to determine its accuracy. National studies by the U. S. Department of Education Office of Educational Research and Improvement National Center for Education Statistics (Paul & Nosich, 1991) identified the need for integration of critical thinking skills into the college curriculum in order for students to be intelligent consumers of information. Hu, Scheuch, Schwartz, Gayles, and Li (2008) stated critical thinking skills are best developed when teachers collaborate with students working on various projects that involve research and problem based learning.

A leading expert in the field of critical thinking, Facione (1990), made significant contributions to the understanding of critical thinking skills within the higher education setting. Through his Delphi project, he gathered the expertise of 46 national experts in critical thinking to produce a consensus of opinion regarding critical thinking. Facione developed several assessments to examine critical thinking skills including the CCTST.

Negative Influences of Standardized Testing

Rote memorization is common in most classrooms and is the primary mode of material acquisition. This passive activity is on a lower level of learning acquisition according to Elder and Paul (2009). Standardized testing does not accurately measure student learning. Critical

thinking challenges what is typically assumed, and critical thinkers recognize the importance of different perspectives in problem solving (Tsui, 2002).

As important as it is to learn and teach critical thinking skills, many teachers are unable to convey this knowledge because of the standardization of content knowledge through drill and testing. The emphasis of standardized testing inhibits the development of critical thinking in the classroom because it forces teachers to narrow the in-depth exploration of content and teach to the test (Diamond, 2007).

According to a review by Moses (2001) many parents, educators, and politicians will one day realize that standardized testing leads to a "dumbed-down" curriculum that values rote memorization over in-depth thinking, exacerbates inequalities for low-income students and students of color, and undermines true accountability among schools, parents, and community. Moses indicated the current trend in education is opposed to critical thinking and prohibitive to an educated populace that is prepared to improve the status quo.

The idea that standardized testing obfuscates the issue of critical thinking being taught on a regular basis in schools is not strictly an American concern. In a study conducted in Jordan (Alazzi & Khawaldeh, 2008) many teachers were under the impression that they were teaching critical thinking skills to their students. After classroom observations were conducted, researchers discovered that the teachers rarely exercised students' critical thinking skills; instead they had students choose answers from a textbook. The Arabic culture in Jordan typically strives for harmony and security. Alazzi (2008) reported that questioning is viewed as opposing the accepted ways of doing things in many Arabic countries and it is not promoted by most educational systems in those countries. By contrast, the United States, founded on the principles of democracy, should recognize that critical thinking, questioning authority, and exercising

freedom is an important function of the educational process (Alazzi, 2008). To push students to excel on tests without challenging them to think critically is counterproductive to the democratic process.

Halpern (2007) stated that knowledge about content area is crucial to critical thinking skills and one cannot think critically about any topic without necessary background information; facts alone are not enough. Critical thinking skills ensure that students will be able to apply put their own perspectives on a topic as opposed to reciting memorized facts. According to Halpern critical thinking and problem solving constitute the skill required not only for college classes but also for the work force.

Results from standardized testing provides lower level incentive for students to do well as opposed to the higher level skill of learning challenging concepts of the world (Moses, 2001). The United States subjects its students to more standardized tests than any other country in the world and must be noted that this plethora of testing does not indicate a vast amount of learning is taking place (Moses, 2001).

Additional Barriers to Critical Thinking

Critical thinking is necessary to create generations of self-regulated lifelong learners (Willingham, 2008). The literature related to the teaching of critical thinking skills denotes multiple barriers. Willingham stated the most important tool of critical thinking is to ask good questions. When questions are asked, others may feel uncomfortable, particularly if they do not want to examine their own ideas. The questioning techniques of Socrates, or Socratic questioning, are used in teaching today. Willingham cautioned that this kind of thinking did not

end well for Socrates, who, due to his constant questioning of the status quo, was sentenced to death.

The evidence researched indicated teachers are ill equipped to teach critical thinking because critical thinking is not a skill that can be taught the way other academic skills are taught (Willingham, 2008). The demands faced by today's educators make the integration of critical thinking into the curriculum an added responsibility.

Teaching critical thinking skills is difficult. Willingham (2008) claimed that people who have sought to teach critical thinking have assumed that it is a skill, and that, like other skills, once it is learned, it can be applied to any situation. The assumption greatly hinders the educational process. Students proceed through school proficiently without being assessed in the ability to draw broad connections within or between all subjects. The brain must be taught to make the association between different subjects in order to achieve meaningful critical thinking and learning that is retained (Healy, 1990).

Teachers must model critical thinking in order for students to understand it, and teachers must be able to think critically and teach critical thinking skills simultaneously (Elder & Paul, 2009). If a teacher is incapable of thinking critically and using multiple perspectives, the teacher will be incapable of demonstrating such skills. As Elder and Paul stated, teachers should model the interconnected system of ideas in the content by thinking aloud slowly and deliberately in the presence of students.

Higher educational facilities must devote attention to equipping future teachers so they will be able to pass along critical thinking skills to students (Law & Kaufhold, 2009). Along with the proper preparation of teachers, an adjustment must be made in the time devoted to the teaching of critical thinking skills. Students must be given sufficient amounts of opportunity to

draw broad conclusions while making application of those concepts to real life experiences (Elder & Paul, 2009).

Constructivism

Constructivism is a philosophy of education characterized by student ownership of the learning process. Learning to think critically is best implemented through constructivism. Brooks and Brooks (1993) viewed constructivism as a philosophy that informs critical thinking. Constructivist learning theory sees knowledge as constructed from the perceptions, experiences, and mental representations of the learner. Meaning is created by the individual and is dependent on the individual's previous and current knowledge structure (Wadsworth, 1971). Learning is a personal experience built upon a scaffold of experience and changes as experience is acquired. Experience enhances knowledge and deep understanding of content (Healy, 1990). Positive interaction and personal relationships within the classroom create an environment conducive to higher order thinking (Healy, 1990). Critical thinking requires students to be actively engaged with not only the content presented but also with others who are also involved. Instead of acceptance of new material at face value, critical thinking requires introspection, reflection, discussion, and interaction.

In spite of the need to promote critical thinking skills in all realms of education, teaching methods elicit responses on a lower level of Bloom's taxonomy (Elder & Paul, 2009). Rote memorization is common in most classrooms and is the primary mode of material acquisition. This passive activity is on a lower level of learning acquisition according to Brookfield (2006). Conversely, constructivist classrooms tend to be more stimulating, challenging, engaging, and interesting. Marzano (2007) stated that constructivist teachers are not passive bystanders. They

provide discussion, illumination, and challenge and serve as facilitators who encourage learners to question knowledge. Teachers must allow students to put together or construct knowledge themselves (Brooks & Brooks, 1993).

The constructivist teacher is not seen as one who imparts knowledge but rather as one who orchestrates an environment that is conducive to individual ownership of knowledge on a personal level. Constructivist teachers look not for what students can repeat verbatim but what they can generate, demonstrate, exhibit, and construct (Brooks & Brooks, 1993).

Content knowledge should be taught through the integration of critical thinking, or as Jenkins (2009) stated, the process should teach students to think. Engaging the brain through critical thinking and problem solving is much more beneficial than memorization of isolated facts (Matheny, 2009). As Jensen (2005) related, the mature brain is wired for problem solving and higher order thinking.

The need to teach content is a significant impediment to the teaching of critical thinking skills. Additional barriers to the implementation of critical thinking include the size of classrooms, the amount of time in class, and teacher attitude (Slavin, 2009). The traditional educational philosophy of the teacher serving as the deliverer of information and the student as a passive receiver of knowledge acutely impedes the development of critical thinking skills (Marzano, 2007). This philosophy of teaching is best identified as essentialism. Essentialism has replaced progressivism, the philosophy of education espoused by John Dewey in the early part of the 20th century.

Progressivism is identified as a philosophy of education that promotes critical thinking. In the progressivist classroom students are encouraged to interact with each other and develop social virtues such as cooperation and tolerance for different points of view (Sadker & Sadker,

2003). Teachers in a progressivist classroom integrate the content of different subjects and plan lessons that arouse curiosity and higher levels of knowledge.

Essentialist teachers and administrators decide what is important for students to learn and place little emphasis on student interest (Sadker & Sadker, 2003). Essentialist teachers focus heavily on achievement test scores as a means of evaluating progress (Sadker & Sadker, 2003). Early in the 20th century essentialism was criticized as too rigid to prepare students for adulthood but after publication of, A Nation at Risk, by the National Commission on Excellence in Education (1983) this philosophy of "back to the basics" regained momentum.

Stages of Critical Thinking

Lynch, Wolcott, and Huber (2002) shared four steps to the developmental sequence of critical thinking skills. Step 1 involves identifying a problem, looking at relevant information, and identifying the uncertainties that may exist. Step 2 is characterized by exploring the various interpretation of a problem and looking for connections from previous learning experiences. Step 3 requires the prioritization of alternatives to a problem and implementing conclusions. Step 4 has the critical thinker envisioning a solution to a problem and directing strategic innovation. The four steps are built upon the foundation of knowledge and skills.

Lynch et al., (2002) identified five stages of critical thinking. The first stage is "confused fact-finders" and attributed to entry-level students typically entering the college classroom. These students are looking for a single right answer and typically want answers from others, especially experts. These students quote from the text and give illogical arguments. These students demonstrate weakness in all the steps of the critical thinking developmental sequence mentioned previously.

The second stage of critical thinking identified by Lynch et al., (2002) is termed a "biased jumper" or a student who easily jumps to conclusions and then looks for supporting evidence. The biased jumper is unaware of personal biases and often ignores contradictory evidence and believes this personal opinion is a valid form of evidence. Lynch et al., indicate students in the second stage display adequate step 1 skills of being able to identify a problem and its relevant information and uncertainties but are weak in all the remaining steps.

The third stage of critical thinking is the "perpetual analyzer" (Lynch et al., 2002). Students in this stage are unable to prioritize information or reach and defend solutions. They exhibit "analysis paralysis" and cannot move beyond the process of analyzing a problem to reach a conclusion. These students demonstrate adequate step 1 skills, achieve step 2 skills of exploring interpretation and connection, but they are weak in the remaining skills of prioritizing and innovation.

The fourth stage is labeled "pragmatic performer" (Lynch et al., 2002). The pragmatic performer examines the evidence objectively and reaches a conclusion. The solutions to problems at this stage tend to be pragmatic and thoughtful. The pragmatic performer stops the continuation of analysis when a solution is reached. Efficient attention to the limitations of a solution to a problem or long-term outlook is implemented. The pragmatic performer is not stuck in the over-analyzing stage. Adequate development of step 1, 2, and 3 skills are achieved. Weaknesses in step 4 skills are noted at this stage.

The final stage of critical thinking acquisition is termed the "strategic revisioner" (Lynch et al., 2002). The individual in this stage seeks lifelong learning and continuous self-improvement. The individual anticipates change and finds ways to get around anticipated limitations as well as the constraints of assumptions. The strategic revisionist is adept in all the

steps of the critical thinking developmental sequence. The information compiled by Lynch et al. is helpful in knowing where students are and envisioning where a teacher would like them to be.

Critical Thinking and Gender

Although critical thinking is a broad topic with much reported literature, relatively little information is available regarding critical thinking and gender. Some studies examine issues that affect critical thinking such as communication differences between males and females, and Wood (1994) presents a list of characteristics of communication that are gender specific. According to Wood feminine talk is more frequently characterized by sharing of feelings and providing support. Females tend to be more careful to wait their turn and ask others for their opinion compared to their male counterparts. Wood stated that for women talking is a human relationship in which details and interesting side comments enhance the depth of connection.

Masculine talk, on the other hand, is more often characterized by assertiveness to establish status and power, gain respect, and win competitions. Competitive speech is described as making personal points to outshine or outdo others. Masculine talk is used frequently to manipulate others in viewing the speaker as confident and in command. Males often appear to be matching experiences as a competitive strategy to command attention as in saying something to the effect of, "I can top that" (Wood, 1994). Wood (1994) further stated males use speech to support others and are characterized as "direct" in giving advice or providing solutions to solve problems. Dow and Wood (2006) continue to support the research that critical thinking skills are perceived differently according to gender. They conclude that females use critical thinking skills and problem solve as much as males but in a style that is less confrontational and direct. This is due in part to some physiological difference in cognition but largely through the effect of culture.

Men and women have differing cognitive strengths from the complex relationship of nature and nurture (Halpern et al., 2007). Halpern et al. reported that women tend to have stronger verbal skills particularly in writing and a better memory for objects, events, words, and activities. Men generally excel in mentally manipulating objects and the performance of quantitative tasks that require visual symbols. Though little research is reported regarded gender and critical thinking, the topic is worthy of further consideration.

Walsh and Hardy (1999) found that in a comparison of academic majors and gender from Facione's California Critical Thinking Disposition Inventory (CCTDI), scores were higher for the majors of English, psychology, and nursing. They also found that in looking at gender differences, female scored higher than males on the CCTDI in open-mindedness and maturity.

A study regarding gender and problem solving administered under the auspice of PISA (Programme for the International Student Assessment) by the Organisation for Economic Co-operation and Development (2009) found that gender differences in problem solving for adolescents were few and insignificant. Although males indicated greater strength in math than females, males demonstrated a wider range of scores with a higher proportion at the highest and lowest levels. Additionally, of the 17 countries assessed, the United States scored 12th in problem solving skills of adolescent students behind Korea, Hong Kong, Japan, Canada, New Zealand, Australia, France, Sweden, Ireland, Spain, and Italy in respective order.

Summary

The review of literature was completed on critical thinking related to early proponents of critical thinking, contemporary practitioners, moral reasoning and critical thinking, negative effects of standardized testing, multiple barriers to teaching critical thinking, constructivism, stages of critical thinking, and gender and critical thinking. Chapter 3 contains a description of the methodology for this study. Chapter 4 describes the data analysis for the study, and Chapter 5 is a summary of findings, implications, and recommendations for future study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Introduction

The purpose of this study was to investigate five dimensions of critical thinking on The California Critical Thinking Skills Test. The data collected from the CCTST included the critical thinking dimensions of analysis, deduction, evaluation, induction, and inference.

Critical thinking has been a topic of interest for many years, and renewed interest has surfaced partly due to accountability factors within the higher education setting. The CCTST has been administered at the university in this study since the school year 2005-2006. The purpose of this study was to determine if there were differences in five dimensions of critical thinking based on students' gender and academic discipline. From the results of this research, insight into effective delivery of educational services to college students may be enhanced. The independent and dependent variables are linked to the dimensions of the CCTST. This chapter included the research design, the population assessed, the instrumentation, the procedures, the data analysis, and a summary of the chapter.

Research Design

This study was designed to use descriptive and inferential statistics to analyze data collected. A quantitative research design was followed to find the association between the dependent and independent variables. In choosing a quantitative research design, the researcher chose to compare the mean scores of groups to determine the interaction between variables of a university students' gender and academic discipline within the five dimensions of the CCTST.

Population

The population for this study is 1,455 graduating seniors for the school year 2009-2010 at a university with an enrollment of approximately 15,000 located in the southeastern United States. The primary service area includes students from 15 primarily rural counties in northeast Tennessee, southwest Virginia, and western North Carolina. The majority of students are residents of the 3 counties surrounding the university. Last semester seniors are required to take the California Test of Critical Thinking Skills.

Instrumentation and Data Collection

The survey instrument used in this study for data collection was the California Critical Thinking Skills Test developed in 1990 by Peter Facione and published by California Academic Press. Although it is important to assess critical thinking to drive educational improvement efforts, obstacles to assessment are present and include what should be measured and what tools should be used for the assessment. One of the premier instruments to evaluate critical thinking is the California Critical Thinking Skills Test.

The purpose of the application of the California Critical Thinking Skills is to determine if individuals have received appropriate instruction and practice in developing critical thinking skills. Additionally, it is useful to determine if students are adequately equipped to apply these skills in the world beyond their college experiences.

Many states require state and federally funded colleges and universities to test graduating seniors with a standardized exam of general education. Results from the CCTST not only measure critical thinking but also the effectiveness of general education in its entirety.

The California Critical Thinking Skills Test, as used at the undergraduate level, consists of 34 multiple choice items that vary in difficulty and complexity. The CCTST is specifically designed so that researchers can use the results with the purpose of evaluating program applicants, developing curriculum, and obtaining standardized data for evaluation, research, and accreditation. The results of each test returns 5 different scores based on different scales including analysis, inference, evaluation, inductive reasoning, and deductive reasoning. There is also a composite result of these totals that results in a critical thinking skills composite test score (California Academic Press, 2006).

The California Critical Thinking Skills Test is used in numerous educational settings worldwide. One particular study by Facione and Facione (2010) looked at the correlations between the test and undergraduate student-related factors regarded as indicators of academic ability and success. The study investigated whether the California Critical Thinking Skills Test efficiently measured improvement in critical thinking or not. Data were gathered on more than 1,000 undergraduate students of California State University, involving some students who were enrolled in courses specifically designed to enhance critical thinking abilities. The investigators were careful to examine instructor-related factors in order to look at extrinsic factors. Testing models looking at the deterioration of skills were developed for predicting opposing results for the test. After repeated comparisons, researchers determined that critical thinking skills could be predicted by a combination of individual verbal Scholastic Aptitude Test—or SAT—score; the mathematics SAT score, and the cumulative GPA, or grade point average. The aptitude test's results were correlated positively with reading test scores for vocabulary, comprehension, and the total score.

The only factor that students encountered during the undergraduate experience that significantly affected any score on the test involved the number of years of teaching experience student's instructors possessed and how recently the students received critical thinking skills instruction. Furthermore, these studies revealed no evidence that indicated improvement in students' critical thinking skills is a result of undergraduate education but a result of educational courses that targeted critical thinking skills (Facione & Facione, 2010).

Each subtest of the CCTST is similar in structure. The subtests present test-takers with different types of questions with the goal of analyzing or interpreting information presented in texts, charts, or images; drawing accurate and warranted inferences; assessing inferences and explaining why they indicate strong or weak reasoning; and explaining why a given evaluation of an inference is either strong or weak (Facione & Facione, 2010)

The CCTST measures how effective college classes have been in teaching critical thinking skills. The CCTST focuses primarily on evaluating core critical thinking skills of analysis-interpretation, inference, and evaluation-explanation. Questions from the test require students to draw inferences, make interpretations, analyze information, identify claims and reasons, and evaluate the quality of arguments.

Ten versions of the CCTST are available, ranging from formats relevant to public education to those appropriate for graduate students. While the tests are different in terms of complexity, all provide objective assessment of critical thinking skills. Analysis, evaluation, and inference are particularly denoted on the CCTST as well as the elements of deductive reasoning and inductive reasoning.

On the CCTST analysis is the ability to pull apart arguments and points of view to show why people think the way they do. It is the means to comprehend and express the meaning or

significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria (Facione & Facione, 2010). This includes the skills of categorization, decoding, significance, and clarifying meaning. In addition analysis from the CCTST includes identifying the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express beliefs, judgments, experiences, reasons, information or opinions Included in this category is examination of ideas, detecting arguments, and analyzing the elements of argument.

On the CCTST evaluation is the ability to decide how strong or weak an argument may be. It is the means to assess the credibility of statements or other representations that are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion. It is also designed to assess the strength of relationships among statements, descriptions, questions, or other forms of representations (Facione & Facione, 2010). Associated with the evaluation dimension are the skills of being able to assess claims and assess arguments. Evaluation as interpreted by the CCTST means to state the results of reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological, and contextual considerations upon which results were based and to present reasoning in the form of cogent arguments. This includes the skills of stating results, justifying procedures, and presenting arguments.

The CCTST uses inference as a means to identify elements needed to draw reasonable conclusions based on reasons and evidence to form hypotheses, to consider relevant information, and to deduce the consequences from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation (Facione & Facione,

2010). Also included are the subskills of querying evidence, drawing conclusions, and discovering alternatives.

Deductive reasoning skills are tested by determining whether a conclusion is true or not. Deductive reasoning is the ability to determine if a conclusion is true if the premises leading to it are true. Clues are given in a particular situation and the test taker must look at the sequence of events, relationship between concepts, and grammatical structure as well (Facione & Facione, 2010).

Inductive reasoning skills on the other hand are the ability to generalize from particular evidence to a valid conclusion. It is further explained as an argument's conclusion by the assumed truth of its premises (California Academic Press, 2006). Inductive reasoning makes a determination if an argument is true or not. Scientific confirmation and experimental disconfirmation are examples of inductive reasoning.

The content validity of the CCTST is directly related to its relationship to the APA Delphi Report research. Consideration of concurrent validity must address the external criterion to be assessed. Indication of concurrent validity for the CCTST is compared to other measures of college students' aptitude and achievement. Total scores correlate significantly with college level grade point average ($r=.200$, $p<.001$), SAT verbal ($r=.550$, $p<.001$) SAT math ($r=.439$, $p<.001$), and the Nelson–Denny Reading scores ($r=.491$, $p<.001$), which are themselves described as predictors of freshman level college grade point average. Construct validity of the CCTST is supported by the pretest-posttest measure of significant gains in cases but not in controls (Facione, 1990), as well as by the high and significant correlation ($r=.667$, $p<.001$) reported between the CCTST and the CCTDI being reported in several pilot and study samples (Facione & Facione, 1992).

The Kuder-Richardson internal reliability coefficients for each of the sections of the divided sample ranged from .68-.69. This internal consistency estimate of reliability is positive. Nonhomogenous instruments designed to test a range of a complex constructs, instruments where items are intended to discriminate well between subjects, and instruments that depend upon dichotomous scoring (Facione, 1990), a level of internal reliability is considered to be .65-.75. Using these criteria, the KR-20 of .68-.69 supports the reliability to measure critical thinking skills.

The difference in CCTST total scores by gender was not significant at the $p<.05$ level of probability although the overall mean scores for males (16.3) was higher than that of females (15.9) in the study involving nursing students. Gain scores were significant by gender ($p<.013$) with males showing a significantly larger gain (1.2 overall) than females (0.4 overall). Conversely, females in the sample had generally higher college grade point averages than the males.

Research Questions and Related Hypotheses

The following research questions and corresponding null hypotheses guided this study.

1. Are there significant differences in the analysis dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA will be used to test the following null hypotheses:

   $Ho1_1$: There are no significant differences in the mean scores for the analysis dimension of the 2009-2010 California Critical Thinking Skills Test among major schools and colleges at the university studied.

$Ho1_2$: There is no significant difference in the mean scores for the analysis dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho1_3$: There is no significant difference in the mean scores for the analysis dimension of the 2009-2010 California Critical Thinking Skills Test with regard to the interaction of gender and college.

2. Are there significant differences in the Induction dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA will be used to test the following null hypotheses:

   $Ho2_1$: There are no significant differences in the mean scores for the Induction dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

   $Ho2_2$: There is no significant difference in the mean scores for the Induction dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

   $Ho2_3$: There is no significant difference in the mean scores for the Induction dimension of the 2009-2010 California Critical Thinking Skills Test with regard to the interaction of gender and college.

3. Are there significant differences in the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA will be used to test the following null hypotheses:

$Ho3_1$: There are no significant differences in the mean scores for the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

$Ho3_2$: There is no significant difference in the mean scores for the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho3_3$: There is no significant difference in the mean scores for the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test with regard to the interaction of gender and college.

4. Are there significant differences in the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA will be used to test the following null hypotheses:

   $Ho4_1$: There are no significance differences in the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

   $Ho4_2$: There is no significant difference in the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

   $Ho4_3$: There is no difference in the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test with regard to the interaction of gender and college.

5. Are there significant differences in the Inference dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA will be used to test the following null hypotheses:

   $Ho5_1$: There are no significance differences in the mean scores for the Inference dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

   $Ho5_2$: There is no significance difference in the mean scores for the Inference dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

   $Ho5_3$: There is no difference in the mean scores for the Inference dimension of the 2009-2010 California Critical Thinking Skills Test with regard to the interaction of gender and college

Data Analysis

Both descriptive and inferential statistics were used to evaluate the five research questions. Null hypotheses were tested using a series of two-way analysis of variance (ANOVA) models. The data were analyzed using SPSS statistical package. The independent variables in the study are gender and the five academic colleges at a university in the southeast United States. The dependent variables are the scores on the dimensions of critical thinking from the CCTST. The .05 level of significance was used as the alpha level to test each hypothesis.

Summary

Chapter 3 was a description of the methodology for this study. The chapter included research design, population and sampling procedures, instrumentation and data collection, research question and related hypotheses, statistical tests, and data analysis. The population included 1,450 graduating seniors at a specific university in the southeast United States. Each student was administered The California Test of Critical Thinking Skills. The results were tabulated and analyzed statistically using SPSS. The purpose of this study was to determine the relationship of university students' gender and academic discipline to critical thinking.

CHAPTER 4

ANALYSIS OF DATA

Chapter 4 described the results of the analysis of the research questions identified in Chapters 1 and 3. The purpose of this study was to investigate five dimensions of critical thinking on the California Critical Thinking Skills Test. The study was designed to analyze whether there exists a significant interaction among the dependent and independent variables. The dependent variables were the dimension scores from the California Critical Thinking Skills Test. The independent variables were the major academic disciplines and the gender of students within a university setting of 15,000 students in the southeast United States. The CCTST includes the dimensions of Analysis, Deduction, Evaluation, Induction, and Inference. This study was guided by four research questions and the corresponding null hypotheses introduced in Chapter 3. The research questions and the null hypotheses are addressed in this chapter.

Research Question 1

Are there differences in the Analysis dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses:

> $Ho1_1$: There are no differences in the mean scores for the Analysis dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.
>
> $Ho1_2$: There is no difference in the mean scores for the Analysis dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho1_3$: There is no significant two-way college by gender interaction for the Analysis

A two-way analysis of variance (ANOVA) was conducted to evaluate the effects on the Analysis dimension of the 2009-2010 California Critical Thinking Skills Test colleges (Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing, and Public Health) and gender (male and female). The means and standard deviations for the Analysis dimension scores by college and gender are presented in Table 1. The ANOVA showed no significant college by gender interaction, F (6, 1488) = .757, p = .604, partial $\eta^2 < .01$, and no significant main effect of gender, F (1, 1488) = .964, p = .326, partial $\eta^2 < .01$. However, the main effect of college was significant, F (6, 1488) = 3.012, p = .006, partial $\eta^2 = .01$. Null hypothesis $Ho1_1$ was rejected. Null hypotheses $Ho1_2$ and $Ho1_3$ were retained.

Because the F test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of college means were different. A Tukey procedure was used because equal variances were assumed, F (6, 1502) = 1.702, p = .117. The results of this analysis showed students in the School of Nursing had a significantly higher mean on the analysis dimension (M = 4.86) than Business and Technology students (M = 4.47), Continuing Studies students (M = 4.22), and Education students (M = 4.37). None of the other pairs of means were statistically different. Table 1 shows the distribution of the means and standard deviations for the Analysis dimension scores by college and gender. Figure 1 shows the frequency of the Analysis dimension scores by college and gender.

Table 1

Means and Standard Deviations for the Analysis Dimension of the California Critical Thinking Skills Test by College and Gender

College	Gender	*M*	*SD*	*n*
Arts and Sciences	Female	4.59	1.38	291
	Male	4.61	1.35	197
	Total	4.59	1.37	488
Business and Technology	Female	4.52	1.30	134
	Male	4.44	1.36	259
	Total	4.47	1.34	393
Clinical and Rehabilitative Health Sciences	Female	4.78	1.24	78
	Male	4.56	1.59	9
	Total	4.76	1.28	87
Continuing Studies	Female	4.24	1.64	29
	Male	4.21	1.21	29
	Total	4.22	1.43	58
Education	Female	4.30	1.32	207
	Male	4.56	1.40	70
	Total	4.37	1.34	277
Nursing	Female	4.83	1.21	138
	Male	5.21	1.48	14
	Total	4.86	1.24	152
Public Health	Female	4.74	1.12	31
	Male	5.25	.93	16
	Total	4.91	1.08	47
Total	Female	4.56	1.33	908
	Male	4.54	1.36	594
	Total	4.56	1.34	1502

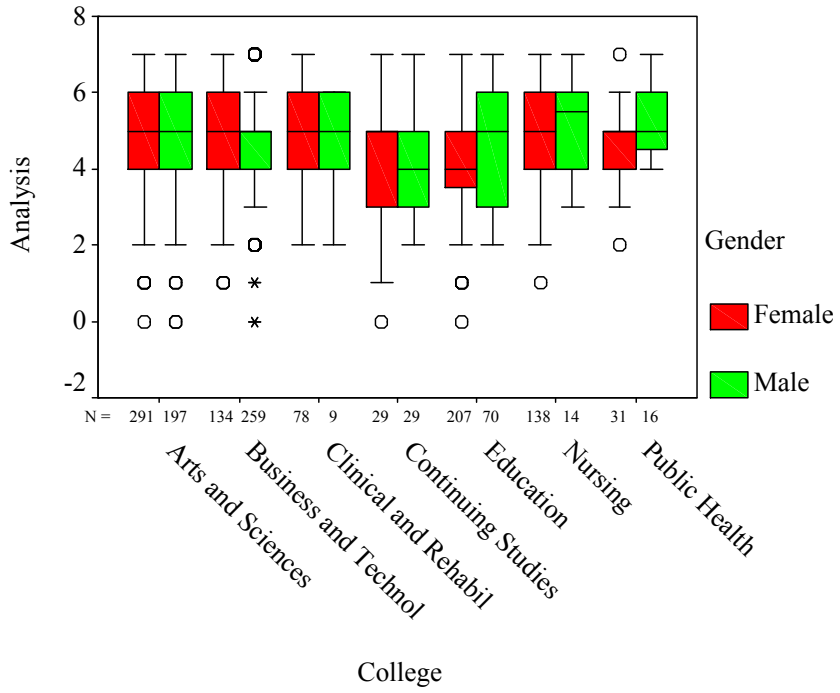


Figure 1.

Boxplot for the Analysis Dimension Scores by College and Gender.

Note: o = an observation between 1.5 times to 3.0 times the interquartile range;

* = an observation which is more than 3.0 times the interquartile range

Research Question 2

Are there differences in the Induction dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses:

$Ho2_1$: There are no differences in the mean scores for the Induction dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

$Ho2_2$: There is no difference in the mean scores for the Induction dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho2_3$: There is no significant two-way college by gender interaction for the Induction Dimension of the 2009-2010 California Critical Thinking Skills Test.

A two-way analysis of variance (ANOVA) was conducted to evaluate the effects on the Induction dimension of the 2009-2010 California Critical Thinking Skills Test at a university in the southeast United States. (Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing, and Public Health) and gender (male and female). The means and standard deviations for the Induction dimension scores by college and gender are presented in Table 2. The ANOVA showed no significant college by gender interaction, F (6, 1488) = .534, p = .783, partial $\eta^2 < .01$. However, the main effect of college was significant, F (6, 1488) = 4.313, $p < .001$, partial $\eta^2 = .01$ and the main effect of male and female scores was significantly different F (1, 1488) = 11.276, p = .001, partial $\eta^2 < .01$ with the mean for males (M = 10.26) significantly higher than the mean for females (M = 9.73). Null hypothesis $Ho2_3$ was retained. Null hypotheses $Ho2_1$ and $Ho2_2$ were rejected.

Because the *F* test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of college means were different. A Tukey procedure was used because equal variances were assumed, F (6, 1502) = 1.235, p = .285. The results of this analysis showed students in the Arts and Sciences (M = 10.30) and the School of Nursing (M = 10.34) had a significantly higher mean on the Induction dimension than Education students (M = 9.32). None of the other pairs of means were statistically different. Table 2 shows the distribution of the means and standard deviations for the Induction dimension scores by college and gender. Figure 2 shows the frequency of the Induction dimension scores by college and gender.

Table 2

Means and Standard Deviations for the Induction Dimension of the California Critical Thinking Skills Test by College and Gender.

College	Gender	*M*	*SD*	*n*
Arts and Sciences	Female	10.11	2.62	291
	Male	10.57	2.69	197
	Total	10.30	2.65	488
Business and Technology	Female	9.31	2.71	134
	Male	10.04	2.84	259
	Total	9.79	2.81	393
Clinical and Rehabilitative Health Sciences	Female	9.77	2.27	78
	Male	10.11	1.83	9
	Total	9.80	2.22	87
Continuing Studies	Female	9.07	2.76	29
	Male	10.52	2.67	29
	Total	9.79	2.79	58
Education	Female	9.17	2.52	207
	Male	9.76	2.64	70
	Total	9.32	2.56	277
Nursing	Female	10.28	2.46	138
	Male	10.86	2.85	14
	Total	10.34	2.49	152
Public Health	Female	9.71	2.36	31
	Male	11.19	2.26	16
	Total	10.21	2.40	47
Total	Female	9.73	2.59	908
	Male	10.26	2.74	594
	Total	9.94	2.66	1502

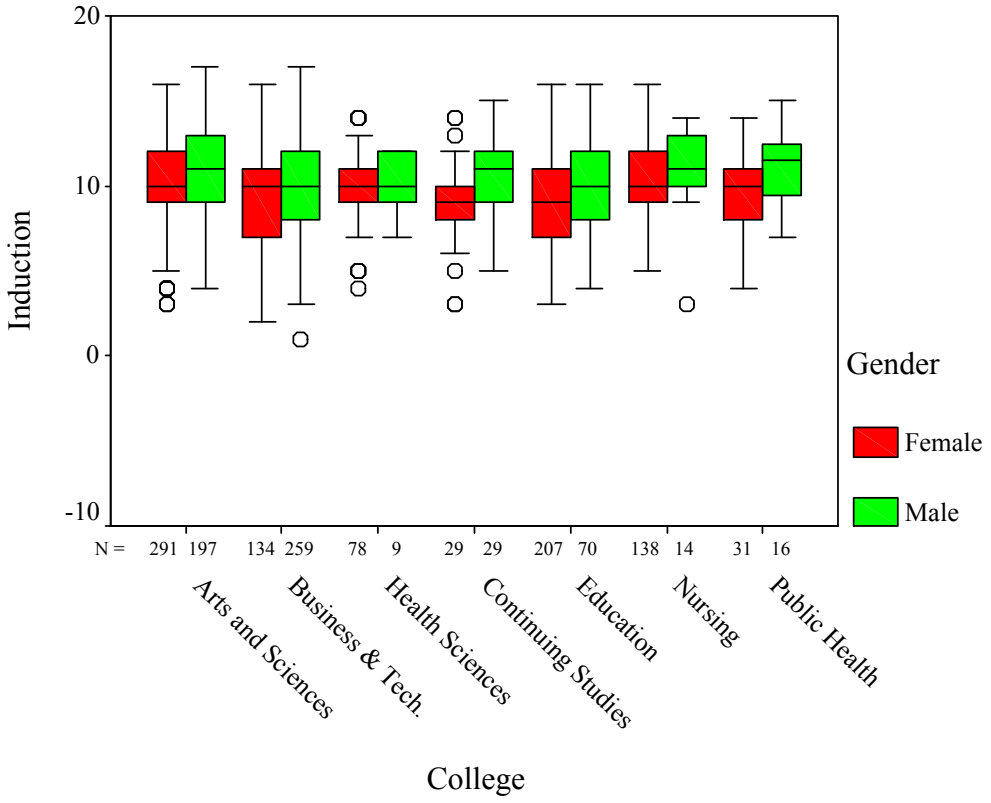


Figure 2.

Boxplot for the Induction Dimension Scores by College and Gender.

Research Question 3

Are there differences in the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses:

$Ho3_1$: There are no differences in the mean scores for the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

$Ho3_2$: There is no difference in the mean scores for the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho3_3$: There is no significant two-way college by gender interaction for the Deduction dimension.

A two-way analysis of variance (ANOVA) was conducted to evaluate the effects on the Deduction dimension of the 2009-2010 California Critical Thinking Skills Test by colleges (Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing and Public Health) and gender (male and female). The means and standard deviations for the Deduction dimension scores by college and gender are presented in Table 3. The ANOVA showed no significant college by gender interaction, F (6, 1488) = .980, p = .437, partial $\eta^2 < .01$, but the main effect of male and female scores were significantly different, F (1, 1488) = 26.591, $p < .001$, partial $\eta^2 < .01$ with the mean for males (M = 8.00) significantly higher than the mean for females (M = 6.92). Additionally, the main effect of college was significant, F (6, 1488) = 4.148, p = < .001, partial $\eta^2 = .01$. Null hypothesis $Ho3_3$ was retained. Null hypotheses $Ho3_1$ and $Ho3_2$ were rejected.

Because the *F* test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of college means were different. A Tukey procedure was used because equal variances were assumed, F (6, 1502) = 1.959, p = .068. The results of this analysis showed students in Business and Technology (M = 7.63) and Arts and Sciences (M = 7.74) had a significantly higher mean on the deduction dimension than Clinical and Rehabilitative Health Sciences (M = 6.28) and Education students (M = 6.61). None of the other pairs of means were statistically different. Table 3 shows the distribution of the means and standard deviations for the Deduction dimension scores by college and gender. Figure 3 shows the frequency of the Deduction dimension scores by college and gender.

Table 3

Means and Standard Deviations for the Deduction Dimension of the California Critical Thinking Skills Test by College and Gender

College	Gender	*M*	*SD*	*n*
Arts and Sciences	Female	7.43	2.60	291
	Male	8.19	3.05	197
	Total	7.74	2.81	488
Business and Technology	Female	7.04	2.50	134
	Male	7.93	3.03	259
	Total	7.63	2.89	393
Clinical and Rehabilitative Health Sciences	Female	6.06	2.18	78
	Male	8.11	4.23	9
	Total	6.28	2.51	87
Continuing Studies	Female	6.34	2.58	29
	Male	8.10	3.13	29
	Total	7.22	2.98	58
Education	Female	6.46	2.33	207
	Male	7.06	2.76	70
	Total	6.61	2.45	277
Nursing	Female	7.03	2.57	138
	Male	9.00	2.42	14
	Total	7.21	2.61	152
Public Health	Female	7.13	3.16	31
	Male	8.00	1.79	16
	Total	7.47	2.78	47
Total	Female	6.93	2.54	908
	Male	7.95	3.00	594
	Total	7.33	2.78	1502

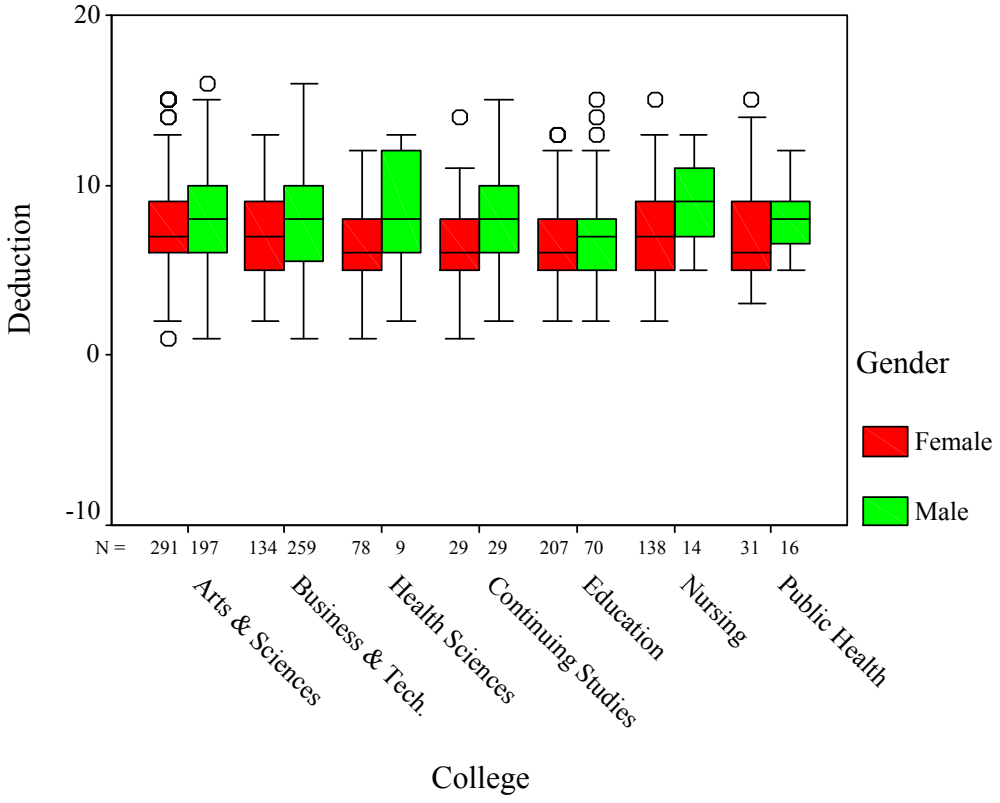


Figure 3.

Boxplot for the Deduction Dimension Scores by College and Gender.

o = an observation between 1.5 times to 3.0 times the interquartile range

Research Question 4

Are there differences in the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses: (more inconsistent spacing between lines in this section)

$Ho4_1$: There are no differences in the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

$Ho4_2$: There is no difference in the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho4_3$: There is no significant two-way college by gender interaction for the evaluation dimension.

A two-way analysis of variance (ANOVA) was conducted to evaluate the effects on the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test by colleges (Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing and Public Health) and gender (male and female). The means and standard deviations for the Evaluation dimension scores by college and gender are presented in Table 4. The ANOVA showed no significant college by gender interaction, F (6, 1488) = .509, p = .802, partial $\eta^2 < .01$; however, the main effect of college was significant, F (6, 1488) = 5.828, p = < .001, partial $\eta^2 < .01$, and the main effect of gender was significant, F (1, 1488) = 18.553, p = < .001, partial $\eta^2 = .01$ with the mean for males (M = 5.18) significantly higher than the mean for females (M = 4.55). Null hypothesis $Ho4_3$ was retained. Null hypotheses $Ho4_1$ and $Ho4_2$ were rejected.

Because the *F* test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of college means were different. A Tukey procedure was used because equal variances were assumed, F (6, 1502) = 1.953, p = .069. The results of this analysis showed students in the College of Arts and Sciences (M = 5.22) had a significantly higher mean on the evaluation dimension than Business and Technology students (M = 4.78), Clinical and rehabilitative Health Sciences students (M = 4.25) and Education students (M = 4.29). None of the other pairs of means were statistically different. Table 4 shows the distribution of the means and standard deviations for the Evaluation dimension scores by college and gender. Figure 4 shows the frequency of the Evaluation dimension scores by college and gender.

Table 4

Means and Standard Deviations for the Evaluation Dimension of the California Critical Thinking Skills Test by College and Gender.

College	Gender	*M*	*SD*	*n*
Arts and Sciences	Female	5.00	1.99	291
	Male	5.54	2.19	197
	Total	5.22	2.09	488
Business and Technology	Female	4.36	2.01	134
	Male	5.00	2.11	259
	Total	4.78	2.10	393
Clinical and Rehabilitative Health Sciences	Female	4.18	1.64	78
	Male	4.89	1.54	9
	Total	4.25	1.64	87
Continuing Studies	Female	4.10	1.82	29
	Male	5.48	2.67	29
	Total	4.79	2.37	58
Education	Female	4.17	1.88	207
	Male	4.63	2.09	70
	Total	4.29	1.94	277
Nursing	Female	4.70	2.07	138
	Male	5.57	1.91	14
	Total	4.78	2.07	152
Public Health	Female	4.35	1.91	31
	Male	5.31	1.54	16
	Total	4.68	1.83	47
Total	Female	4.55	1.97	908
	Male	5.18	2.16	594
	Total	4.80	2.07	1502

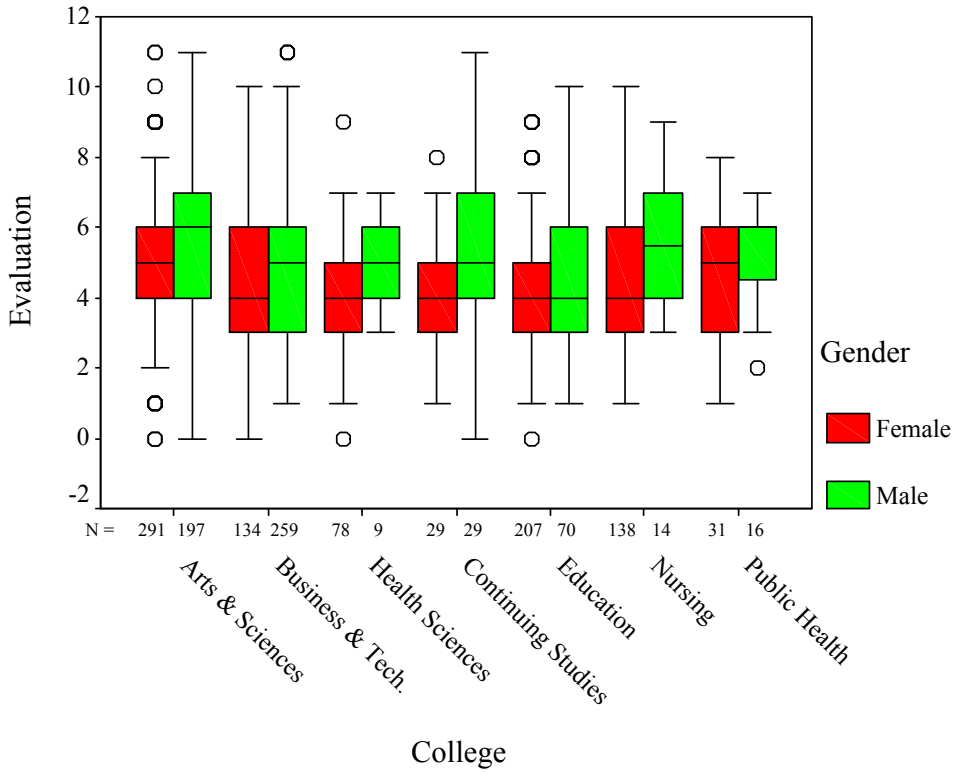


Figure 4. Boxplot for the Evaluation Dimension Scores by College and Gender.

o = an observation between 1.5 times to 3.0 times the interquartile range

Research Question 5

Are there differences in the Inference dimension of the 2009-2010 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses: (more inconsistent spacing between lines)

$Ho5_1$: There are no differences in the mean scores for the Inference dimension of the 2009-2010 California Critical Thinking Skills Test among colleges.

$Ho5_2$: There is no difference in the mean scores for the Inference dimension of the 2009-2010 California Critical Thinking Skills Test between male and female students.

$Ho5_3$: There is no significant two-way college by gender interaction for the Inference dimension.

A two-way analysis of variance (ANOVA) was conducted to evaluate the effects on the Inference dimension of the 2009-2010 California Critical Thinking Skills Test by colleges (Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing and Public Health) and gender (male and female). The means and standard deviations for the Inference dimension scores by college and gender are presented in Table 5. The ANOVA showed no significant college by gender interaction, F (6, 1488) = 1.172, p = .319, partial $\eta^2 < .01$. However, the main effect of college was significant, F (6, 1488) = 3.413, p = .002, partial η^2 = .01 and the main effect of male and female scores were significantly different F (1, 1488) = 27.156, p = < .001, partial $\eta^2 < .01$ with the mean for males (M = 8.49) significantly higher than the mean for females (M = 7.55). Null hypothesis $Ho5_3$ was retained. Null hypotheses $Ho5_1$ and $Ho5_2$ were rejected.

Because the F test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of college means were different. The test

of homogeneity of variances showed equal variances cannot be assumed, F (6, 1502) = 3.049, p = .006; therefore, for the Inference dimension a Tukey test could not be used. Dunnett's C, which does not assume equal variances, was used instead.

Dunnett's C results showed students in the School of Arts and Sciences (M = 8.211) and students in Business and Technology (M = 8.17) had a significantly higher mean on the Inference dimension than Clinical and Rehabilitative Health Sciences (M = 7.07) and Education students (M = 7.28). None of the other pairs of means were statistically different. Table 5 shows the distribution of the means and standard deviations for the Inference dimension scores by college and gender. Figure 5 shows the frequency of the Evaluation dimension scores by college and gender.

Table 5

Means and Standard Deviations for the Inference Dimension of the California Critical Thinking Skills Test by College and Gender.

College	Gender	*M*	*SD*	*n*
Arts and Sciences	Female	7.95	2.36	291
	Male	8.60	2.79	197
	Total	8.21	2.56	488
Business and Technology	Female	7.47	2.31	134
	Male	8.53	2.76	259
	Total	8.17	2.66	393
Clinical and Rehabilitative Health Sciences	Female	6.87	2.02	78
	Male	8.78	3.38	9
	Total	7.07	2.25	87
Continuing Studies	Female	7.07	2.55	29
	Male	8.93	2.49	29
	Total	8.00	2.67	58
Education	Female	7.16	2.09	207
	Male	7.63	2.52	70
	Total	7.28	2.21	277
Nursing	Female	7.78	2.09	138
	Male	9.07	2.56	14
	Total	7.90	2.16	152
Public Health	Female	7.74	2.93	31
	Male	8.63	1.96	16
	Total	8.04	2.65	47
Total	Female	7.55	2.28	908
	Male	8.49	2.73	594
	Total	7.92	2.51	1502

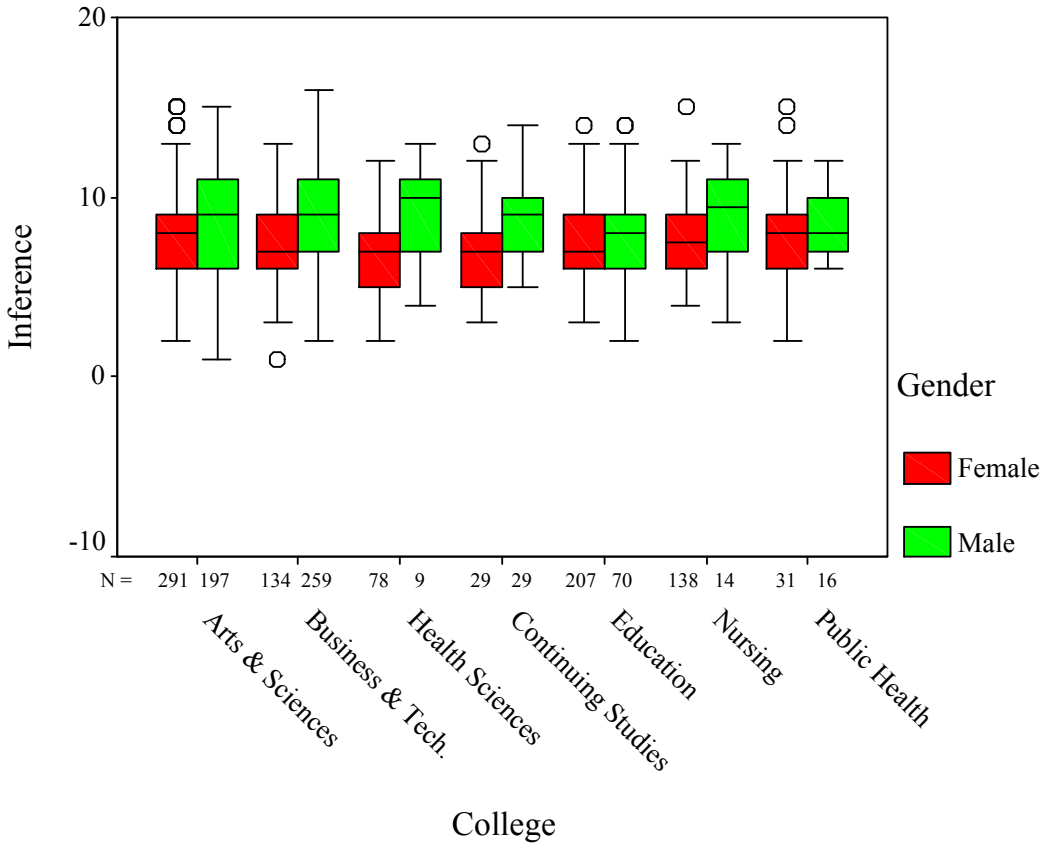


Figure 5.

Boxplot for the Inference dimension for college and gender.

o = an observation between 1.5 times to 3.0 times the interquartile range

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Improving critical thinking skills in higher education has remained a topic of discussion and a focus of varying importance for many years. Even in an educational climate that focuses its funding and attention to success on standardized tests, it is a general consensus among higher education faculties that research relating to the development of critical thinking skills is of paramount importance (Paul, 1993). In an effort to prepare students for entering the global labor market, law-makers, administrators, and educators are remiss if students leave institutions of higher education unprepared to approach the myriad problems of the world of work lacking the ability to think critically. This study demonstrates that a clear mandate to teach students to think critically must be adopted and enforced.

The purpose of this study was to explore the relationship of the five dimensions of critical thinking as measured by The California Critical Thinking Skills Test to gender and academic discipline of graduating seniors at a university in the southeast United States. Furthermore, this study was initiated to determine if there were differences in five dimensions of critical thinking based on college and based on gender.

The development of critical thinking skills is dependent upon instruction. Teachers encourage the development of critical thinking by arranging the learning environment, demonstrating critical thinking, and implementing techniques that encourage active student engagement. The most prevalent mode of instruction in higher education classrooms unfortunately continues to be the traditional approach of content delivery in the form of teacher lecture designed to promote the memorization of isolated facts and serves to reduce student interest. Among the best educated faculties it is the general consensus that the development of

students' critical thinking skills is necessary to prepare individuals to perform optimally in an ever-changing world.

The results of this study indicate that students within certain academic disciplines perform better in some areas of critical thinking. Gender differences in critical thinking indicate the need for further study.

Levene's test for equality of variances was conducted on each analysis to determine if the variances could be considered equal. If the test were found to lack significance, equal variance was reported. Significance as reported by the Levene's test resulted in equal variance not assumed. It is recommended that the listing of unequal sample size cited as a limitation to the study is unnecessary to avoid the assumption of homogeneity of variances.

Summary of Findings

The statistical analyses were governed by the five research questions introduced in Chapter 1 and clarified in Chapter 3. The dependent variable for each analysis was the dimension score on the California Critical Thinking Skills Test. The CCTST scores were organized into the major colleges and schools at a university. The independent variables were gender and college of major study. The population consisted of approximately 1,500 graduating seniors at a university in the southeast United States.

Research Question 1

Are there differences in the Analysis dimension of the 2009-10 California Critical Thinking Skills Test based on college and gender? The ANOVA showed no significant college by gender interaction, F (6, 1488) = .757, p = .604, partial $\eta^2 < .01$, and no significant main

effect of gender, F (1, 1488) = .964, p = .326, partial $\eta^2 < .01$. However, the main effect of college was significant, F (6, 1488) = 3.012, p = .006, partial $\eta^2 = .01$. Null hypothesis $Ho1_2$ was retained. $Ho1_1$ and $Ho1_3$ were rejected.

Because the F test for the main effect of college was significant, post hoc pairwise comparisons were conducted to determine which pairs of means were different. A Tukey procedure was used because equal variances were assumed, F (6, 1502) = 1.702, p = .117. The results of this analysis showed students in the School of Nursing had a significantly higher mean on the Analysis dimension (M = 4.86) than Business and Technology students (M = 4.47), Continuing Studies students (M = 4.22), and Education students (M = 4.37). None of the other pairs of means was statistically different.

Research Question 2

Are there differences in the induction dimension of the 2009-10 California Critical Thinking Skills Test based on the college and gender? A two-way ANOVA was used to test the hypotheses. The main effect for college was significant. The results of this analysis showed students in the Arts and Sciences (M = 10.30) and the School of Nursing (M = 10.34) had a significantly higher mean on the Induction dimension than Education students (M = 9.32). None of the other pairs of means were statistically different. The main effect for gender was significant with the mean for males (M = 10.26) significantly higher than the mean for females (M = 9.73). The results indicated there was not significant gender by college interaction for the Induction dimension of the 2009-2010 CCTST. The null Hypothesis $Ho2_3$ was retained and the null hypotheses $Ho2_1$ and $Ho2_2$ were rejected.

Research Question 3

Are there differences in the deduction dimension of the 2009-10 California Critical Thinking Skills Test based on college and gender? College by gender interaction was not significant. The main effect of college was significant. The results of this analysis showed students in Business and Technology ($M = 7.63$) and Arts and Sciences ($M = 7.74$) had a significantly higher mean on the Deduction dimension than Clinical and Rehabilitative Health Sciences ($M = 6.28$) and Education students ($M = 6.61$). None of the other pairs of means were statistically different. The main effect of gender was significant with the mean for males ($M = 8.00$) significantly higher than the mean for females ($M = 6.92$). The null Hypothesis $Ho3_3$ was retained and the null hypotheses $Ho3_1$ and $Ho3_2$ were rejected.

Research Question 4

Are there differences in the evaluation dimension of the 2009-10 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the following null hypotheses. The results indicated the mean scores for the Evaluation dimension of the 2009-2010 California Critical Thinking Skills Test among the five colleges was significant. The results of this analysis showed students in the College of Arts and Sciences ($M = 5.22$) had a significantly higher mean on the evaluation dimension than Business and Technology students ($M = 4.78$), Clinical and rehabilitative Health Sciences students ($M = 4.25$), and Education students ($M = 4.29$). None of the other pairs of means were statistically different. The main effect of the Evaluation dimension on the 2009-10 California Critical Thinking Skills Test between male and female students was significant with the mean for males ($M = 5.18$)

significantly higher than the mean for females ($M = 4.55$). The two-way college by gender interaction for the Evaluation dimension is not significant. The null Hypothesis $Ho4_3$ was retained and the null hypotheses $Ho4_1$ and $Ho4_2$ were rejected.

Research Question 5

Are there differences in the Inference dimension of the 2009-10 California Critical Thinking Skills Test based on college and gender? A two-way ANOVA was used to test the null hypotheses. The results indicated the main effect of college was significant for the Inference dimension. Because equal variances could not be assumed a Tukey test could not be used. Dunnett's C, which does not assume equal variances, was used instead. Dunnett's C results showed students in the School of Arts and Sciences ($M = 8.211$) and students in Business and Technology ($M = 8.17$) had a significantly higher mean on the Inference dimension than Clinical and Rehabilitative Health Sciences ($M = 7.07$) and Education students ($M = 7.28$). None of the other pairs of means were statistically different. The main effect of gender was significant with the mean for males ($M = 5.18$) significantly higher than the mean for females ($M = 4.55$). College by gender interaction is not significant. The null Hypothesis $Ho5_3$ was retained and the null hypotheses $Ho5_1$ and $Ho5_2$ were rejected.

Recommendations for Practice

Findings from this study include implications for practice by higher education instructors addressing critical thinking skills. The results of this study indicate a need for further research and training in content delivery accompanied by critical thinking. Mapping the higher education curriculum in order to adjust course content to reduce the amount of replicated information taught in courses is highly recommended. A focus on problem-based learning, active learning, and a constructivist approach is recommended to facilitate critical thinking skills and learning that is meaningful and lasting. It is recommended that faculty be instructed in effective teaching methods that include:

1. Sharing videotaped classroom instruction where critical thinking is demonstrated.
2. Incorporating critical thinking skills in appropriate topics in classroom instruction.
3. Training higher education instructors in active learning strategies that facilitate critical thinking skills.
4. Designing course content around themes applicable to a variety of situations to encourage active learning activities and critical thinking.
5. Sharing results from the CCTST to establish a baseline and determine goals for improvement.
6. Implementing strategies of individual colleges, schools, and departments that score well on the CCTST.
7. Courses in critical thinking skills within every major.
8. Implementing a rubric for critical thinking skills within every course.
9. Mapping the higher education curriculum within each college to circumvent content repetition and omission.

Recommendations for Further Research

This study was not intended to be an all-encompassing research study on critical thinking skills and gender. Other studies of the CCTST that have been or may be conducted at other universities may have similar findings. Because this study was conducted at a specific university in the Southeast region of the United States, the findings of the study may not be generalized to other collegiate institutions. However, the findings of the study all or in part may have relevance to other universities using the CCTST. Qualitative studies should be performed to investigate successful use of the instrument in institutions of higher education. Several recommendations for additional research may be made as a result of this study. The following are suggested:

1. Research to investigate successful higher education instruction that incorporates successfully critical thinking skills.
2. Research to determine strategies to combine content coverage with critical thinking skills.
3. Research regarding exploration into gender differences in approaching problem solving and critical thinking strategies.
4. Research to determine why students in certain colleges of major study outperform other colleges in critical thinking skills.
5. Research to determine student perceptions about the value of critical thinking.
6. Research to determine faculty perceptions of the value to students' critical thinking.
7. Research to elucidate the financial and physical costs of training faculty and implementing critical thinking programs and the cost-to-benefit ratio.
8. Research into the efficacy of courses in critical thinking within every major.

9. Further research how to reconcile conceptual frameworks underlying measures of critical thinking with an instructional plan to teach critical thinking skills.

It is evident that research needs to be conducted in the field of critical thinking. Furthermore, it is apparent that in order for the United States to compete globally and to prepare the next generation for the rigors required for the modern workforce, young people must develop the skills necessary to think critically and problem solve in increasingly innovative ways.

REFERENCES

Alazzi, K. (2008). Teachers' perceptions of critical thinking: A study of Jordanian secondary school social studies teachers. *The Social Studies*, 99, 243-248.

Alazzi, K., & Khawaldeh, A. (2008). Do they really teach critical thinking in the social studies classroom? A study of Jordanian secondary school social studies teachers. *Teaching and Learning*, 22, 93-103.

Bensley, D. (2008). Thinking critically about critical thinking approaches: Comment on Yancer, Slife,& Warne. *Review of General Psychology*, 13, 275-277.

Black, S. (2005). Teaching students to think critically. *The Education Digest*, 70(6), 42-47.

Bloom, B. (1974). *The taxonomy of educational objectives: Affective and cognitive domains.* New York: David Mckay.

Bok, D. (2006). *Our underachieving colleges.* Princeton, NJ: Princeton University.

Brookfield, S. (2006). *The skillful teacher: On technique, trust, and responsiveness in the classroom*. San Francisco: Jossey-Bass.

Brooks, J., & Brooks, M. (1993). *The case for constructivist classrooms.* Alexandria, VA: Association of Supervision and Curriculum Development.

California Academic Press. (2006). *Insight assessment-tools to evaluate reasoning and critical thinking: California Critical Thinking Skills Test (CCTST).* Millbrae, CA: author.

Clabaugh, G. K. (2008). Thinking critically about "critical thinking." *Educational Horizons, 86,* 129-133.

Department of Education National Educational Goals 2000 Panel. (1992). *National education Goals report: Executive summary building a nation of learners*. Washington, DC: The U. S. Government Printing Office.

DeVoogd, G. (2006). Question authority: Kids need to be skeptical of the curriculum. It's the only way to develop a balanced view of the world. *School Library Journal*, 52(4), 48-50.

Diamond, J.B. (2007). Where the rubber meets the road: Rethinking the connection between high-stakes testing policy and classroom instruction. *Sociology of Education*, 80, 285-313.

Dunwoody, P.T., & Frank, M.L. (1995). Why students withdraw from classes. *The Journal of Psychology, 129,* 553-558.

Dow, B.J., & Wood, J.T. (2006). *The Sage handbook of gender and communication.* Thousand Oaks, CA: Sage.

Elder, L., & Paul, R. (2009). Critical thinking: Strategies for improving student learning, Part III. *Journal of Developmental Education, 3,* 40.

Facione, N.C., & Facione, P.A. (1992). *The California critical thinking disposition inventory test manual*. Millbrae, CA: California Academic Press.

Facione, N.C., & Facione, P.A. (2010). *The California critical thinking skills test manual.* Millbrae, CA: California Academic Press.

Facione, P. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction.* Millbrae, CA: California Academic Press.

Gunn, T., Grigg, L., & Pomahac, G. (2008). Critical thinking in science education: Can bioethical issues and questioning strategies increase scientific understandings? *Journal of Educational Thought*, 42, 165-183.

Halpern, D. (2007). The nature and nurture of critical thinking. *Critical thinking in psychology* (pp. 1-14). New York: Cambridge University.

Halpern, D., Benbow, C., Geary, D., Gur, R., Hyde, J., & Gernsbacher, M. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest,* Vol. 8, No. 1, pages 1-51.

Healy, J. (1990). *Endangered minds why our children don't think.* New York: Simon & Schuster.

Howard, P. (1994). *The owner's manual for the brain.* Austin, TX: Leornian.

Hu, S., Scheuch, K., Schwartz, R., Gayles, G., & Li, S. (2008). *Reinventing undergraduate education: Engaging college students in research and creative activities.* Hoboken, NJ: Wiley.

Inch, E., & Warnick, B. (2010). *Critical thinking and communication.* New York: Custom.

Jenkins, R. (2009). Our students need more practice in actual thinking. *The Chronicle of Higher Education*, 55(29) B18.

Jensen, E. (2005). *Teaching with the brain in mind (2nd Ed.).* Alexandria, VA: Association of Supervision and Curriculum Development.

Kirkwood, W. (2003). *Helping students learn critical thinking skills: A resource manual.* Johnson City: East Tennessee State University.

Knodt, J. (2009). Cultivating curious minds: teaching for innovation through open-inquiry learning. *Teacher Librarian,* 37, 15-22.

Kohlberg, L. (1963). The development of children's orientation toward moral order. I: Sequence in the development of human thought. *Vita Humana, 6,* 11-33.

Law, C., & Kaufhold, J. A., (2009). An analysis of the use of critical thinking skills in reading and language arts instruction. *Reading Improvement, 46,* 29-34.

Lynch, C. L., Wolcott, S. K., & Huber, G. E. (May 31, 2002). Steps for better thinking: A developmental problem solving process [on-line]. Available: http://www.WolcottLynch.com.

Matheny, G. (2009). The knowledge vs. skills debate: A false dichotomy? *Leadership,* 39-40.

Marzano, R. J. (2007). *The art and science of teaching.* Alexandria, VA: Association of Supervision and Curriculum Development.

Moses, L. (2001). Rethinking standardized high stakes testing. *Childhood Education,* 78(1), 58.

National Commission on Excellence In Education (1983). *A nation at risk*: *The imperative for educational reform.* Washington, DC: The U.S. Government Printing Office.

No Child Left Behind Act of 2001, Pub. L. No. 107-110 (2002).

Organisation for Economic Co-operation and Development (2009). *Pisa 2009 Assessment Framework.* Programme for the International Student Assessment. Vol. 1.

Paul, R. W. (1993). The logic of creative and critical thinking. *American Behavioral Scientist,* 37, 21-39.

Paul, R., & Elder, L. (2008). The miniature guide to critical thinking: Concepts and tools (5th Ed.). Dillon Beach, CA: Foundation for Critical Thinking.

Paul, R., & Nosich, G. (1991). *A Proposal for the national assessment of higher order thinking.* Washington, DC: The US Department of Education Office of Educational Research and Improvement National Center for Education Statistics.

Piaget, J. (1952). *The origins of intelligence in children*. New York: Basic.

Piaget, J., & Inhelder, B. (1971). *The Psychology of the child.* New York: Basic.

Sadker, M. & Sadker, D.. (2003). *Teachers, schools, and society.* 6th Ed. New York: McGraw-Hill.

Slavin, R. (2009). *Educational psychology theory and practice* (9th Ed.). Upper Saddle River, NJ: Pearson.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition*. Chicago: University of Chicago.

Trottier, J. (2009). Talking skepticism to generation y. *Skeptical Inquirer,* 33, 6.

Tsui, L. (2002). Fostering critical thinking through effective pedagogy: Evidence from four institutional case studies. *Journal of Higher Education, 73, 740-763.*

Vygotsky, L.S. (1986). *Thought and language.* Cambridge, MA: Harvard University.

Wadsworth, B. (1971). *Piaget's theory of cognitive development from childhood to adolescence: A constructivist perspective.* New York: Holt, Rinehart, and Winston.

Walsh, C., & Hardy, R., (1999). Dispositional differences in critical thinking related to gender and academic major. *Journal of Nursing Education, 38, 149-155.*

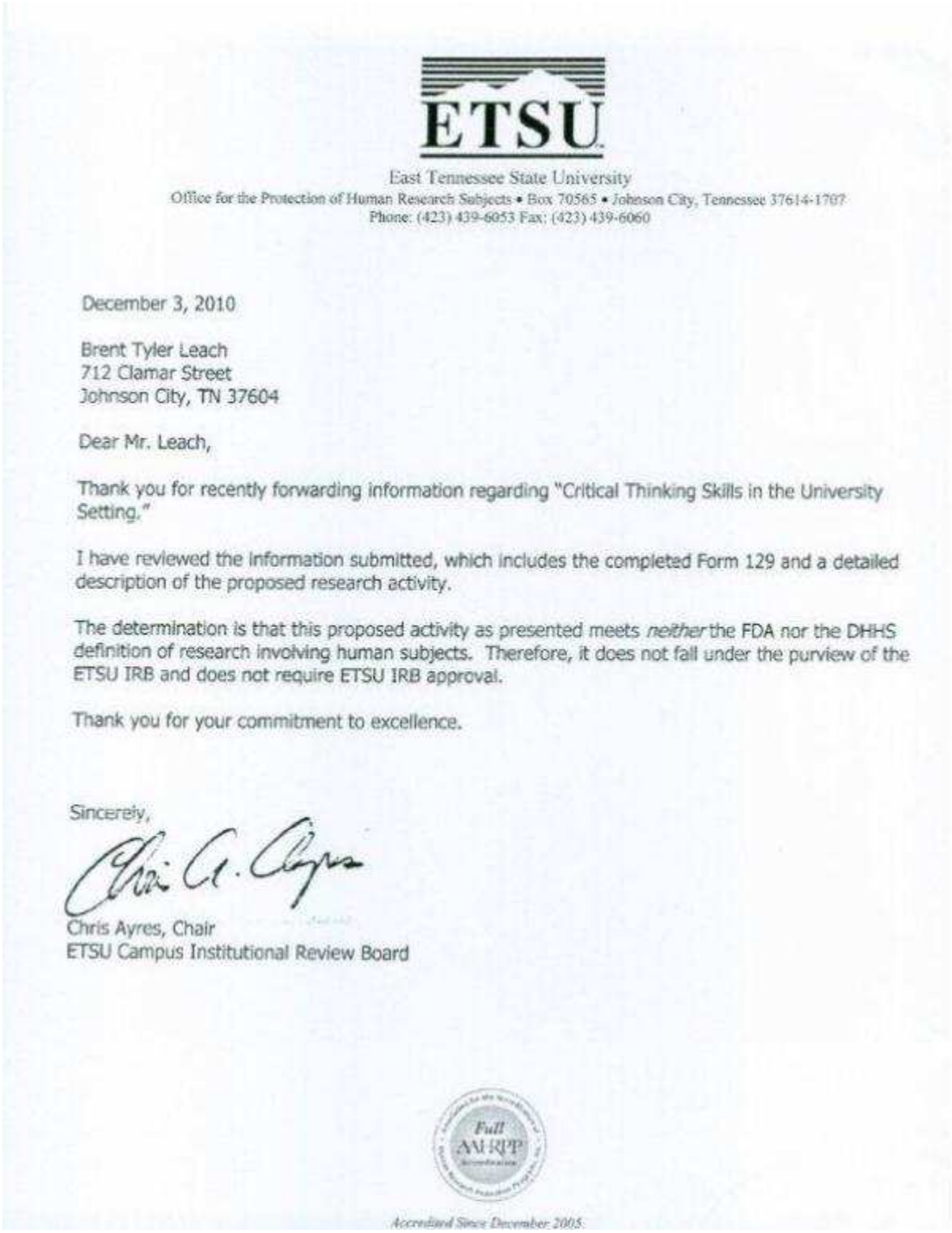
Willingham, D. T. (2008). Critical thinking: Why is it so hard to teach? *Arts Education Policy Review*, *109,* 21-29.

Willingham, D. T. (2009). *Why don't students like school? A cognitive scientist answers questions about how the mind works and what it means for the classroom.* San Francisco: Jossey-Bass.

Wood, J. (1994). *Gendered lives: Communication, gender, and culture.* Belmont, CA: Wadsworth.

APPENDIX

IRB Approval



ETSU

East Tennessee State University

Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707

Phone: (423) 439-6053 Fax: (423) 439-6060

December 3, 2010

Brent Tyler Leach
712 Clamar Street
Johnson City, TN 37604

Dear Mr. Leach,

Thank you for recently forwarding information regarding "Critical Thinking Skills in the University Setting."

I have reviewed the information submitted, which includes the completed Form 129 and a detailed description of the proposed research activity.

The determination is that this proposed activity as presented meets *neither* the FDA nor the DHHS definition of research involving human subjects. Therefore, it does not fall under the purview of the ETSU IRB and does not require ETSU IRB approval.

Thank you for your commitment to excellence.

Sincerely,

Chris Ayres, Chair
ETSU Campus Institutional Review Board

Full AAHRPP Accreditation

Accredited Since December 2005

VITA

BRENT TYLER LEACH

Education:	Ed.D. Educational Leadership, East Tennessee State University, Johnson City, Tennessee 2011
	Education Specialist, East Tennessee State University, Johnson City, Tennessee 1997
	M. Ed. Counseling, East Tennessee State University, Johnson City, Tennessee, 1986
	B. S. University of Tennessee Elementary Education/Special Education, Knoxville, Tennessee, 1977
Professional Experience:	Full time adjunct instructor, Human Development and Learning, East Tennessee State University, 2007-2011
	Adjunct faculty for Virginia Intermont College, Milligan College, and Northeast State Technical Community College, 1995-2011.
	Special Education Diagnostician, Johnson City, Tennessee, 1987-2006.
	Behavior Management Specialist, Kingsport City Schools; Kingsport, Tennessee, 1979-1987.
Honors/Affiliations	Kappa Delta Pi Honor Society
	State of Tennessee Easy IEP Task Force
	Chair of special education parent/community relations
	Board of Directors for ARK Farm
	Mike Simmons Staff Development Scholarship Award
	Gamma Beta Phi Honor Society

Certified Professional Counselor State of Tennessee

Tamassee Park Board of Directors

Conference Presentations: Active Learning Strategies for Online Students. Presented at Virginia Intermont College, 2010.

English Language Learners and Special Education Service. Presented at Regional Training for Northeast Tennessee Educators, Johnson City, Tennessee (2007).

Update on Inclusion. Presented at Northeast Tennessee Special Education Conference (2007).

Gifted Education Interventions Utilizing Multiple Intelligences. Presented at Parent training Conference Johnson City, Tennessee Schools (2006).

Educational Services and Procedures Related to ADHD. Presented at Mountain States Health Alliance Resources (2004).

Innovative Classroom Practices for Teachers. Presented at Northeast Tennessee Special Education Conference (2004).

Memberships: Association of Supervision and Curriculum Development

Council for Exceptional Children

Kappa Delta Pi Honor Society

Gamma Beta Phi Honor Society

Phi Delta Kappa Honor Society

Tennessee Association of Administrators of Special Education