

University of Memphis

University of Memphis Digital Commons

Electronic Theses and Dissertations

11-28-2011

Critical Thinking Skills in Allied Health Students

Marcia Yvette Sharp

Follow this and additional works at: <https://digitalcommons.memphis.edu/etd>

Recommended Citation

Sharp, Marcia Yvette, "Critical Thinking Skills in Allied Health Students" (2011). *Electronic Theses and Dissertations*. 371.

<https://digitalcommons.memphis.edu/etd/371>

This Dissertation is brought to you for free and open access by University of Memphis Digital Commons. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of University of Memphis Digital Commons. For more information, please contact khggerty@memphis.edu.

CRITICAL THINKING SKILLS IN ALLIED HEALTH STUDENTS

by

Marcia Yvette Sharp

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Education

Major: Higher and Adult Education

The University of Memphis

December 2011

Acknowledgements

This long journey would not have been possible without the support of my family. I am grateful to my husband, Darren, who supported me through this process. I am also grateful to my kids, Shannon and Darren (D.J.), for keeping me focused on the important things in life.

I would like to thank Drs. Meyer, Murrell, Reynolds, and Wilson for serving on my dissertation committee. This process would not have been possible without their expertise and guidance.

I offer many thanks to my colleagues and friends at the University of Tennessee Health Science Center, Department of Health Informatics and Information Management who believed in me and encouraged me every step of the way. I share this accomplishment with Mamel, Rebecca, and Beth and could not have done it without them. Also, a special thanks goes to my friend, Keisha, who was by my side every step of the way.

Finally, but certainly not least, I am grateful to my grandmother, Mattie, who passed away on Mother's Day of this year. She was always there to support me, offer a word of encouragement, make me laugh, and keep me focused on family and God. She would be happy to know that I have finally finished my dissertation.

Abstract

Sharp, Marcia Yvette. Ed.D. The University of Memphis. December 2011. Critical Thinking Skills of Allied Health Students. Major Professor: Dr. Katrina Meyer, Ph.D.

This study examines the critical thinking skills of allied health students (AHS) at a southeastern university. A survey methodology was utilized to investigate the critical thinking skills of AHS in cytotechnology, dental hygiene, health informatics and information management, and medical technology disciplines. The Health Sciences Reasoning Test (HSRT) was the survey instrument used to measure students' critical thinking skill level. The survey was administered to 57 graduating seniors in the College of Allied Health Sciences class of 2011.

Five research questions guided the study:

1. What is the critical thinking skill level of allied health students at a southeastern university (strong, moderate, or weak)?
2. Are there differences in critical thinking skills based on program of allied health students?
3. Are there differences in critical thinking skills based on gender of allied health students?
4. Are there differences in critical thinking skills between programs taught at different academic levels (baccalaureate, entry-level masters, and masters)?
5. What is the impact of academic level, age, gender, grade point average and program on critical thinking skills of allied health students?

Results indicated that 64.9% of the participants in the study had weak critical thinking skills, 31.6% of the participants had moderate critical thinking skills and 3.5% of the

participants had strong critical thinking skills. Additionally, an independent t-test indicated that male participants scored higher on the HSRT than females. ANOVA analysis indicated differences in critical thinking based on academic level. Bachelor participants' critical thinking skills were lower than master's and entry-level master's participants. Surprisingly, entry-level master's students scored higher than master's level students. Finally, multiple regression results indicated that 31.7% of the variance in total critical thinking skills can be explained by gender, age, program, GPA, and academic level.

One important contribution of this research is that it adds to the body of literature surrounding critical thinking skills of allied health students. This study is also the first study to investigate multiple allied health disciplines at a single time. The study provides new information to deans, administrators, and educators that may be useful when evaluating critical thinking skills of allied health students.

Table of Contents

List of Tables	vii
CHAPTER 1 INTRODUCTION	
Statement of the Problem.....	1
Importance of the Topic.....	3
Purpose of the Study	4
Method	4
Significance of the Study	5
Definitions.....	6
Limitations	7
Summary.....	7
CHAPTER 2 LITERATURE REVIEW	
Introduction.....	8
Definition of Critical Thinking	9
Critical Thinking and Age	13
Critical Thinking and Gender Differences.....	15
Critical Thinking in Higher Education	17
Critical Thinking in Health Professions.....	19
Critical Thinking in Allied Health Professions.....	22
Critical Thinking Instruments	27
Summary.....	30
CHAPTER 3 METHODOLOGY	
Methodology	32
Research Design.....	32
Research Questions.....	32
Overview of Study Participants	33
Instrument	33
Procedures.....	35
Variables	37
Data Analysis	38
Summary.....	41
CHAPTER 4 DATA ANALYSES, FINDINGS, AND RESULTS	
Participant Demographics.....	42
Research Questions.....	44
Summary.....	52

CHAPTER 5 SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Summary54
Limitations56
Implications.....56
Recommendations.....60

REFERENCES62

APPENDICES

APPENDIX A: Informed Consent.....77
APPENDIX B: Approval by University of Tennessee IRB78
APPENDIX C: Approval by University of Memphis IRB80

List of Tables

Table

1	Critical Thinking Instruments	29
2	Demographic Characteristics of Allied Health Students ($N = 57$).....	43
3	Descriptive Statistics of Participants by Program Type and Degree Seeking	44
4	Critical Thinking Skill Level ($N = 57$).....	45
5	Descriptive Statistics of Health Sciences Reasoning Test Scores ($N = 57$).....	46
6	Results of ANOVA for Critical Thinking Score by Program Type.....	47
7	Descriptive Statistics of Health Sciences Reasoning Test Scores by Gender	48
8	Descriptive Statistics of Health Sciences Reasoning Test by Academic Level.....	49
9	Results of ANOVA for Critical Thinking Score by Academic Level	50
10	Results of Regression Model	50
11	Model Summary R-Square Statistics	51
12	Model Summary Coefficients	51

Chapter 1

Statement of the Problem

Today, more than ever, educational institutions are challenged to develop students who have adequate critical thinking skills. From the time of Socrates to the 21st century, the need for an educated workforce has been an ongoing necessity. The educational goals for the year 2000, announced by President Bush and state governors in 1990, included the attainment of critical thinking skills (Corrallo, 1991). "Although the ability to think critically has always been important, it is a vital necessity for citizens of the 21st century" (Halpern, 2003, p. 3). Twenty-first century citizens must sift through a vast array of information regarding financial, health, civic, even leisure activities in order to formulate plausible plans of actions (Partnership for 21st Century Skills, 2010, p. 13).

Despite widespread inclusion of critical thinking as an educational goal, studies have shown that schools neither challenge students to think critically about academic subjects nor help them develop the reasoning skills needed to succeed in the 21st century (Arum & Roksa, 2011; Halpern, 1997). "On average, gains in critical thinking, complex reasoning and writing skills (i.e., general collegiate skills) during the first two years of college are either exceedingly small or empirically non-existent for a large proportion of students" (Learning in Higher Education, 2011, p. 1). Forty-five percent of students in a study conducted by Arum and Roksa (2011) did not demonstrate any significant improvement in Collegiate Learning Assessment (CLA) performance during the first two years of college. This study reports that many college students graduate without knowing how to sift fact from opinion, make a clear written argument or objectively review conflicting reports of a situation or event (Arum & Roksa, 2011). Additionally, Arum and

Roksa (2011) found that particular fields of study vary the extent to which they contribute to growth in reasoning skills; students concentrating in math and science courses have higher levels of improvement in reasoning skills than students in education, human services, or business subject areas.

Higher education institutions are not alone in recognizing the importance of critical thinking; employers demand workers who can think analytically, solve complex problems, and use sound reasoning skills in various situations. In a study conducted by Hart Research Associates (2010) “Raising the Bar: Employers’ Views on College Learning in the Wake of the Economic Downturn,” employers suggest that colleges and universities place more emphasis on critical thinking and analytical reasoning skills. In reference to hiring, this report indicates that employers’ greatest emphasis will be on hiring graduates from four-year colleges and universities (Hart Research Associates, 2010). One major industry hiring college graduates is the healthcare industry. Because lives are at risk in the healthcare industry, it is even more important that college graduates and students majoring in the health sciences have adequate critical thinking skills.

One often overlooked but vitally important area of the health sciences are the allied health sciences. Allied health science professionals:

are involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases and disorders; dietary and nutrition services; rehabilitation and health systems management, among others.

Allied health professionals include dental hygienists, diagnostic medical sonographers, dietitians, health information managers, medical technologists, occupational therapists, physical therapists, radiographers, respiratory therapists,

and speech language pathologists. (Association of Schools of Allied Health Professions (ASAHP), 2011, p. 1)

Several studies have been conducted in physical therapy, occupational therapy, and dental hygiene (Williams et al., 2003) assessing the critical thinking skills of allied health students; however, to date, no one has investigated several allied health programs collectively at one time. This study is an attempt to accomplish this task and add to the body of knowledge by assessing the critical thinking skills of allied health students enrolled in various allied health programs at a southeastern university.

Importance of the topic

Development of critical thinking skills among allied health students is essential. Every day allied health professionals must gather, analyze and process information to make sound, logical decisions. Often the decisions are complex and require multiple levels of decision-making. Regardless of the magnitude of the decision, it is essential that allied health students have the clinical reasoning and critical thinking skills to make good decisions. Willingham (2007) states that critical thinking occurs when a student penetrates beyond the surface of a problem and recognizes how the problem can be solved and possesses the content knowledge needed to solve the problem. Allied health students learn the respective content knowledge through their specific allied health disciplines and must demonstrate this knowledge by passing registration or licensing examinations. But do these students have critical thinking skills and the abilities to apply those skills in several different contexts? Can deans, program directors, and department chairs at colleges and universities be assured that they are graduating students who can think critically in complex situations and become productive citizens of society? As

accrediting agencies and policymakers continue to raise the bar and place more accountability on higher education institutions, it is important that attention remains on graduating students who can think critically.

Purpose of the study

The primary purpose of this study is to determine the critical thinking skill level of allied health students at a southeastern university, as measured by the Health Sciences Reasoning Test. The secondary purpose of this study is to investigate if relationships exist between HSRT scores, age, gender, grade point average, and academic level. The primary research questions are:

1. What is the critical thinking skill level of allied health students at a southeastern university (strong, moderate, or weak)?
2. Are there differences in critical thinking skills based on program of allied health students?
3. Are there differences in critical thinking skills based on gender of allied health students?
4. Are there differences in critical thinking skills between programs taught at different academic levels (baccalaureate, entry-level masters, and masters)?
5. What is the impact of academic level, age, gender, grade point average and program on critical thinking skills of allied health students?

Method

This quantitative research study is both descriptive and exploratory. Data will be collected through the administration of an assessment using a commercial survey tool, the Health Sciences Reasoning Test. This assessment will be administered to the allied

health sciences graduating class of 2011 at a southeastern school of allied health sciences. The instrument gathers information regarding demographic variables and an overall critical thinking score. The data will be subsequently analyzed with Statistical Package for the Social Sciences (SPSS) 19.0 using both descriptive and inferential statistics to determine the critical thinking skill level of allied health science students.

Significance of the study

With the increased push for colleges and universities to improve the critical thinking skills of its healthcare graduates, more studies need to be conducted to determine if allied health students are graduating with the higher-order, critical thinking skills needed for the 21st century workplace. Despite the work that has been conducted on critical thinking, research in the critical thinking skills of allied health professions lags behind. The results of the study will help to establish a foundation for allied health sciences programs to determine the level of critical thinking skills their graduates possess. This study can inform deans, program directors, and department chairs, as well as faculty, on the extent to which critical thinking is demonstrated in their program graduates. Results of the study can provide a foundation for faculty to make changes in the curriculum to improve students' critical thinking skills. Additionally, the results can provide information to allied health students by identifying areas where their critical thinking skills are strong or weak. Lastly, results of the study can show the public that students graduating from allied health programs possess the critical thinking skills and can contribute to the workforce as productive, responsible citizens.

Definitions

Adult learner - Adult learners include students 21 years of age or older during the first day of enrollment in an educational program at a degree granting institutions. An adult is legally defined as an individual at least 21 years of age (Chu & Hinton, 2001; Wlodkowski, Mauldin, & Gahn, 2001).

Allied Health profession - Allied Health professionals are involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases and disorders; dietary and nutrition services; rehabilitation and health systems management, among others. Allied health professionals, to name a few, include dental hygienists, diagnostic medical sonographers, dietitians, medical technologists, occupational therapists, physical therapists, radiographers, respiratory therapists, and speech language pathologists (ASAHP, 2011.)

Clinical reasoning – the ability to analyze, evaluate, and make inferences based on available evidence (Williams & Worth, 2001).

Critical thinking: “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment was based” (Facione & Facione, 1994, p. 4).

Health Sciences Reasoning Test - a multiple choice test that targets core critical thinking skills of health sciences professionals and health science. It measures five subscale critical thinking areas, including inductive reasoning, deductive reasoning, analysis, inference, and evaluation students (Facione & Facione, 2005).

Limitations

This study is limited to an academic health science center geographically located in the southeastern United States. While results of this study may be typical for allied health students in this region, they may not be indicative of allied health students in other regions of the United States. Participants are limited to only those students enrolled and expected to graduate in the Spring of 2011 so the demographics and backgrounds of the allied health student population may not be typical of those in other parts of the United States. This study is also constrained by the participants' willingness to respond and includes data collected at one collection point in the students' academic career. Another limitation in the study is that the participants complete the online version of the Health Sciences Reasoning Test (HSRT) in an un-proctored environment. The accuracy of self-reported data from the participants is another limitation. Grade point average prior to entering the program and highest education level obtained could be inflated and not reflective of other allied health students.

Summary

As higher education institutions continue to face challenges such as graduating more students, increase critical thinking skills among students, and increase accessibility for students, it is crucial that research regarding assessing the critical thinking skill level of college students continue. The data collected in this study will add to the body of literature surrounding the critical thinking skill level of allied health students.

Chapter 2

Literature Review

Introduction

Critical thinking is a major educational outcome required of higher education institutions. *The New York Times* reports that:

An unprecedented study that followed several thousand undergraduates through four years of college found that large numbers didn't learn the critical thinking, complex reasoning and written communication skills that are widely assumed to be at the core of a college education. Many of the students graduated without knowing how to sift fact from opinion, make a clear written argument or objectively review conflicting reports of a situation or event, according to New York University sociologist Richard Arum, lead author of the study. Arum, whose book "Academically Adrift: Limited Learning on College Campuses" released January 2011, followed 2,322 traditional-age students from the fall of 2005 to the spring of 2009 and examined testing data and student surveys at a broad range of 24 U.S. colleges and universities, from the highly selective to the less selective. Forty-five percent of students made no significant improvement in their critical thinking, reasoning or writing skills during the first two years of college, according to the study. After four years, 36 percent showed no significant gains in these so-called higher order thinking skills. (Steinberg, 2011, p. 1)

The goal of teaching essential skills, such as critical thinking, in higher education is to prepare students to become more effective employees and responsible citizens (Erwin & Sebrell, 2003). This literature review will explore the definitions of critical thinking,

aspects of critical thinking regarding age and gender differences, critical thinking in higher education, critical thinking in the healthcare professions, and ending with critical thinking in the allied health professions.

Definition of Critical Thinking

Although the principles of critical thinking underpin much of western philosophy, it did not come to the forefront as a specific concept until the late Nineteenth Century. Philosophical discussion of critical inquiry surfaced in the 1870s in the United States, when Charles Sanders Peirce, who believed that logic is the scientific method that will lead to truth, originated the concept of pragmatism. Pragmatism stresses the relation of theory to practice (or what Paulo Freire called ‘praxis,’ meaning reflection and action upon the world in order to change it) (Damji, Dell’Anno, McGrath, & Warden, 2001). John Dewey, the noted educator who argued for a model of critical thinking based on a theory of knowing that is continuous, adopted Peirce’s notion of meaning, and focused on the connection between thinking and experience, doing, and the consequences of action (Damji et al, 2001). Dewey also subscribed to the philosophical school known as pragmatism, and described his approach to inquiry as “reflective thinking” to distinguish it from ordinary thinking (Damji et al., 2001). John Dewey (1933) used the term reflective thinking to describe thought based on reflection, related to beliefs. This concept of reflective thinking has been viewed as a forerunner of the current usage of the term critical thinking.

Robert Ennis (1986), who developed the Cornell Critical Thinking Tests, defined critical thinking as reasonable, reflective thinking that is focused on deciding what to do or believe. Daley, Shaw, Balistreri, Glasenapp, and Piacentine (1999), Kuper (2002), and

Rivers (2001) describe critical thinking as a metacognitive process of purposeful judgment that includes self-directed learning and self-assessment. Metacognition refers to the ability of the learner to be aware of and monitor their learning process (Peters, 2000). Brookfield (1997) and Norris (1985) expanded the concept of critical thinking by describing components of critical thinking including challenging assumptions, imagining alternatives, considering the context of a situation, and engaging in reflective skepticism. According to Pascarella and Terenzini (1991), critical thinking stresses an individual's ability to interpret, evaluate, and make informed judgments about the adequacy of arguments, data, and conclusions. In contrast, formal reasoning, a related concept devised by Jean Piaget, has been typically related to solving operational tasks or problems (Pascarella & Terenzini, 1991). Some scholars use "critical thinking" and "higher-order thinking" interchangeably (Halpern, 1993). Rudd, Baker, and Hoover (2000) define critical thinking as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation and inference" (p. 2). According to Sim (2003), critical thinking is accomplished by shifting away from teacher centered activities toward student centered activities which place the responsibility for learning on the student. Winch (2004) refers to the ability of a person to think critically as critical rationality, defining it as possessing the higher-order level skills to evaluate arguments and evidence in an informative manner.

The relationship among critical thinking, higher-order thinking, thinking skills and other terms such as informal logic, informal reasoning, problem solving, argumentation, critical reflection, reflective judgment, and metacognition have made it difficult to grasp the true definition of critical thinking (Giancarlo & Facione, 2001). In

1990, under the sponsorship of the American Philosophical Association (APA), a cross-disciplinary panel completed a two-year Delphi project yielding a robust conceptualization of critical thinking as an outcome of college level education (APA, 1990). Before the Delphi Project, no clear consensus existed on the definition of critical thinking, although the concepts advanced by Brookfield, Daley, Dewey, Ennis, Kuper, Norris, Paul, and Pierce, among others, were influential. The Delphi project was an attempt to achieve a consensus of opinions by a panel of experts in critical thinking for the purposes of educational instruction and assessment (Facione, 1990). Forty-six experts, drawn from various disciplines, participated in the multi-year qualitative research project. About half (52%) of the participants were philosophers, and the rest were affiliated with education (22%), the social sciences including psychology (20%), and the physical sciences (6%). The report resulting from this investigation is commonly known in the critical thinking literature as the Delphi Report. The Delphi Report identified critical thinking as “one among a family of closely related forms of higher-order thinking, along with, for example, problem solving, decision-making, and creative thinking” (Facione, 1990, p. 13). Facione, the organizing participant, has pointed out that these terms overlap conceptually and complexly, and that the relationships among them have yet to be satisfactorily examined. The experts’ consensus statement on critical thinking follows:

We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical thinking is essential as

a tool of inquiry. As such, critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, critical thinking is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (Facione, 1990, p. 2)

Like the Delphi experts, many other scholars view higher-order thinking as an umbrella term that includes critical thinking, problem solving, and decision-making. While related to and sharing overlapping skills with problem solving, critical thinking focuses on reasoning, argumentation, and judgment about ill-structured problems. Facione's study (1990) concluded that at the very core of critical thinking are the concepts of interpretation, analysis, evaluation, inference, explanation, and self-regulation.

Further analysis, by the experts in the Delphi study, of each concept found the concept of interpretation as being able to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria. Analysis was found to involve

identifying the relationship between statements, questions, concepts or descriptions to express beliefs, judgments or reasons. The experts thought that evaluation included assessing the credibility of statements and representations of others as well as assessing the logical strength of statements, descriptions or questions. The experts thought that inference included being able to identify elements needed to draw reasonable conclusions. Explanation was about stating and justifying the results of one's reasoning using each of the aforementioned abilities. Self-regulation, the last skill, was found to be the ability of individuals to monitor their own personal cognitive activities to make sure that they are engaged in critical thinking (Facione, 1990).

Though the terminology has changed slightly over the years, developing students' critical thinking skills remains a central goal of the educational process. Research in critical thinking was renewed when the California Critical Thinking Disposition Inventory (CCTDI) was developed by Facione and Facione (1994) based on the Delphi study conducted by the American Philosophical Association (APA).

Critical Thinking and Age

Researchers have demonstrated that older students differ from traditional age students in a variety of ways, including approaches to studying, attitudes towards school, and assertiveness (Eison & Moore, 1980; Gibbs, 1994; King & Kitchener, 1994; Mezirow & Associates, 1990). The question of whether or not these differences also extend to reasoning patterns and critical thinking abilities remains unresolved. Perry's (1970) model of intellectual and moral development, later modified by Belenky et al. (1986) and others (Baxter-Magolda, 1992; King & Kitchener, 1994; Kurfiss, 1988), have established that individuals begin to understand themselves and their ability to think and

reason develops over time. Developmentalists have differed, however, on the age ranges for each stage or position of intellectual development, on whether people develop progressively or in a fluid, back and forth way, and on the impact of plateaus or even reversals in intellectual development (Reed, 1998). Some adult education theorists have argued that critical reflection, an aspect of critical thinking that enables people to examine rationally the assumptions and values by which they justify their beliefs, takes place only in late adolescence or adulthood (Brookfield, 1987; Mezirow & Associates, 1990). They have suggested that the ability to reflect critically happens not merely as a function of physical maturity but because older students are more likely to have developed further in their reasoning and reflective capacity due to challenging experiences. According to these theorists, adult learners may be more open to different viewpoints and more willing to make reasoned judgments based on defined standards. Adult learners include students 21 years of age or older during the first day of enrollment in an educational program at a degree granting institutions. An adult is legally defined as an individual at least 21 years of age (Chu & Hinton, 2001; Wlodkowski, et al., 2001). In contrast to the view that there is a difference in intellectual development and critical reflection between adult learners and traditional-age college students, current research on reasoning and argumentation has not found a difference in peoples' abilities to reason critically by age.

King and Kitchener (1994) have reviewed a number of studies that examined student reasoning about ill structured problems using the Reflective Judgment Model. Their research has indicated that, in contrast to differences found on other educationally relevant dimensions, adult students do not appear to be dramatically different from their

younger counterparts in terms of their reflective thinking. Kuhn (1992), in her study of argumentative reasoning ability on current social issues, has also concluded that reasoning skills do not differ systematically as a function of age after about ninth grade. Her study found no further development in argumentative reasoning skill between early adolescence and adulthood. Kuhn's findings have supported developmental theories that thinking about one's own thoughts and beliefs does not occur until late childhood or early adolescence and that early adolescence is the age at which systematic change can be observed. Perkins (1985), who has investigated informal reasoning other than reflective judgment, has also found that age had no significant impact on reasoning performance. Several studies show age as having no significant difference or no relationship to critical thinking (Cillizza 1970; Claytor 1997; Facione 1990, 1991; Jenkins 1998; Rodriguez 2000; Rudd et al., 2000; Thompson 2001). King and Kitchener (1994), Kuhn (1992), and Perkins (1985) have all found that the amount of formal education is a more powerful predictor of reflective thinking than age or any other demographic variable. The question of whether or not there is a difference in intellectual development and level of critical thinking abilities between adult learners and traditional-age college students has not been settled. For this reason, this study will explore the role of age on critical thinking.

Critical Thinking and Gender Differences

Gender as a predictor of critical thinking skills or dispositions has been evaluated by nearly all of the critical thinking studies. One of the first to consider gender in critical thinking research was Wilson (1989). He studied the critical thinking ability of entering college freshmen (n = 203) using the Watson-Glaser Critical Thinking Assessment (WGCTA) and ACT College Reports. He found that ACT standard scores significantly

accounted for 28.41% of the variance in WGCTA raw scores, but also that gender was a significant predictor of critical thinking skill. This study looked at gender's influence on critical thinking and found that females were more open-minded and mature in their thinking, while males were more analytical (Facione, Giancarlo, Facione, & Gainen, 1995). Walsh (1996) conducted a study of 499 male and female undergraduates. Along with highest eventual degree and major, gender was a variable predicting variance in critical thinking disposition. In a study of undergraduates at the University of Florida that evaluated learning style and critical thinking disposition, Rudd et al. (2000) found significant gender differences ($\alpha = .03$) for scores on the California Critical Thinking Disposition Inventory (CCTDI). Another study trying to ascertain learning style influence on critical thinking combined gender with age and GPA to achieve a significant variance (13%) in critical thinking based on those variables (Torres & Cano, 1995). Since GPA is consistently related to critical thinking, this finding fails to indicate gender's influence. Halpern (2000) observed that there is evidence that cognitive abilities, such as perception, attention, verbal ability, mathematics, and visual-spatial ability, vary as a function of gender. She argues that other variables such as socioeconomic status, cultural background, learning history, and age positively affect cognition (Halpern, 2000).

Additionally, Claytor (1997) found gender and ethnicity to be independent of critical thinking skills. Rodriguez (2000) studied the critical thinking of registered nurses ($n = 60$), but found none of the individual predictors of age, degree, career path, years of experience, personality type, or gender were statistically significant. Pienaar (2000) conducted a South African study of adolescents' critical thinking in the context of political issues, and found that gender had no significant relationship with critical

thinking ability. Thompson (2001) also found that gender had no predictive value of critical thinking or learning style.

Jenkins (1988) used the Watson Glaser Critical Thinking Appraisal and found that gender was not a predictor of critical thinking. Other studies using assessments using the California Critical Thinking Skills Test (CCTST) and California Critical Thinking Disposition Instrument (CCTDI) have also found that gender is not related to or a predictor of critical thinking. King and Kitchener (1994) have suggested that reported differences based on gender may be due to a variety of factors including differences in academic aptitude or rates of maturation. Magolda (1992) has concluded from her research that gender differences in students' reasoning patterns and ways they justify their thoughts are fluid, a continuum with numerous variations and combinations rather than a dichotomy between female and male students. The question of gender differences in critical thinking remains a topic of controversy among scholars. As a result, gender will be studied in this research.

Critical Thinking in Higher Education

Developing critical thinking skills in college and university students is a major concern in higher education institutions. Several strategies have been used to integrate critical thinking into courses. One approach has been to integrate critical thinking across the curriculum. Kurfiss (1988) contends that critical thinking can be implemented without much difficulty in many disciplines: the sciences, mathematics, engineering, the humanities, literature, philosophy, foreign language, and social sciences. For example, in science, math and engineering classes, one can use the principles and strategies of problem-solving, which are similar to the analytical problems on Graduate Record Exams

(GRE) or Scholastic Aptitude Tests (SAT). Another approach has been to develop single courses to teach critical thinking skills (Kurfiss, 1988; Halpern, 1997). Strategies such as the use of concept maps and mind maps as teaching techniques have been used to improve critical thinking skills (Bellezza, 1983; Buzan & Buzan, 1993; D'Antonio, 2009; Hill, 2006; Irvin, 1996).

Using the Watson Glaser Critical Thinking Appraisal (WGCTA), Pascarella (1989) investigated critical thinking abilities of secondary school seniors who did and did not attend college. He administered WGCTA during the students' senior year and then administered it one year later to those who attended college and those who did not attend college. He found students who had one year of college had statistically higher critical thinking total scores than those who did not attend college. Pascarella and Terenzini (1991) observed that the majority of evidence supports the idea that college has a positive net effect on the development of critical thinking skills. They reported that of the five critical thinking studies they analyzed, four suggested that college freshman-senior differences on various measures of critical thinking were not simply the result of individual student academic ability or student maturation.

McMillan (1987) reviewed 27 studies that investigated the effects of various instructional methods, courses, programs, and general college experiences on changes in college students' critical thinking. The results failed to support the use of specific instructional or course conditions to enhance critical thinking; however, it did support the conclusion that college attendance improves critical thinking (McMillan, 1987). In contrast, Arum and Roksa (2011) found that after four years of college, 36 percent of

2,322 traditional age students from the fall of 2005 to the spring of 2009 showed no significant gains in critical thinking skills.

Critical Thinking in Health Professions

Critical thinking is increasingly being recognized as the cognitive engine driving the processes of knowledge development and professional judgment in a wide variety of professional practice fields (Facione & Facione, 1996). Critical thinking is not only essential but an expectation of the health care professionals. The depth and breadth of information that practitioners are expected to master is voluminous. The two major disciplines in healthcare are medicine and nursing. Some studies related to critical thinking and reasoning exist within the medicine discipline (D'Antonio, 2009; Hojat, Borenstein, & Veloski, 1988), but most studies are conducted in nursing (Hill, 2006; Irvin, 1995).

The following studies indicate how researchers used concept map or mind mapping as a teaching strategy to improve critical thinking in a range of health fields. D'Antonio (2009) explored how mind mapping can be used to facilitate critical thinking in medical students. Farrand et al. (2002) suggest that the use of mind mapping fosters student retention of factual information, as well as relationships between concepts. Mind maps are multisensory, using color and pictures, to help convert information from short to long term memory by using visuospatial relationships (Bellezza, 1983; Buzan & Buzan, 1993). Though the mind map technique is a unique strategy that addresses critical thinking; the study concluded that a mind map learning strategy did not result in a significant gain in critical thinking among medical students (D'Antonio, 2009).

Hojat et al. (1988) investigated both cognitive and non-cognitive factors in predicting clinical performance of medical school graduates. Graduates were rated by supervisors using a 33-item Likert scale tool that measured aspects of clinical competence. These scores were compared to scores on the National Board of Medical Examiners (NBME). The investigators found significant predictive value in both the non-cognitive and cognitive factors, with the non-cognitive factors yielding the highest predictive value. Non-cognitive factors included interpersonal skills, attitudes, and personal qualities. The cognitive factors investigated—including knowledge, skills, and technical abilities—were a statistically significant predictor of NBME performance, as measured by the author-developed tool (Hojat et al., 1988).

Irvine (1995) discussed how concept maps were used in nursing to promote meaningful learning in nursing students by linking old and new information. More recently, Hill (2006) showed how nursing students can integrate daily clinical experiences using concept maps. In this qualitative study, nurses were asked to create a map during the information gathering process from patient assessments. Hill argues that this process was meaningful because it allowed the students to visualize changes made to the map over time. Additionally, the nursing instructors felt that the students demonstrated stronger understanding of the nursing process as a result of using concept maps (Hill, 2006).

Most of the studies related to concept maps are primarily in medicine and nursing; however, one study was found in dietetic education- an allied health field. Although this study is an allied health study (which will be discussed in the next section), it will be discussed here since it explored the use of concept mapping also. The study conducted

by Molaison, Taylor, Erickson, and Connell (2009) evaluated the potential efficacy of concept mapping as a learning tool for nutrition assessment among dietetic interns and its acceptability by internship preceptors. Nineteen dietetic interns and 31 preceptors participated in a quasi-experimental pre-post design in which the concept mapping strategy was taught as a replacement for the traditional nutrition care plan. The pre-concept map mean score was significantly lower than the post-concept mean score (28.35 vs. 117.96; $p = 0.001$) based on the student t-test, thus indicating improved critical thinking skills through the use of concept mapping (Molaison et al., 2009)

In addition to concept mapping, other measures related to course curriculum have been investigated. In 1990 Dartmouth Medical School revised its curriculum to improve the critical thinking and clinical decision making abilities of its students (O'Donnell & Baron, 1991). Dartmouth recognized that cramming and mere memorization left students inadequate time for deep cognitive functions such as critical thinking. They integrated competency-based exams, where students demonstrated skills in decision-making, critical thinking, and problem solving, throughout the curriculum.

Several researchers have examined the areas of critical thinking skills of students progressing through nursing education programs (Colucciello, 1999; May, Edell, Butell, Doughty, & Langford, 1999; McCarthy, Schuster, Zehr, & McDoughal, 1999; Wangenstein, 2010). Martin (2002) described the improvement of critical thinking with the students' attainment of knowledge and experience. Other studies investigate critical thinking in staff nurses related to research utilization (Profetto-McGrath, Hesketh, Lang, & Estabrooks, 2003), critical thinking in nurse educators (Raymond & Profetto-McGrath, 2005), critical thinking and evidence-based practice in nursing (Profetto, 2005), and

critical thinking as an essential skill for the nurse manager in the 21st century (Zori, 2009).

In exploring the differences in critical thinking among nurses with varying levels of clinical experience and different academic preparations, Fero, Witsberger, Wesmiller, Zullo, and Hoffman (2009), identify significant differences between the development of critical thinking over time among graduates of diploma, associate and baccalaureate educational programs. Considering experience along with academic preparation, Fero et al. (2009) found that those prepared at the baccalaureate level demonstrate higher levels of critical thinking ability after gaining experience as compared to those prepared through diploma programs. This finding is not consistent with previous studies reporting Performance Based Development System (PBDS) assessment results. Del Bueno (2005) reported that after 10 years of analysis, there are no consistent findings which indicated differences in clinical judgment ability based on educational preparation or credentialing, whereas (Fero et al., 2009) found a difference in testing outcome based on level of preparation.

Elam (2001) conducted a study with optometry students to determine whether or not differences in critical thinking skills between academic levels (first and third year students) and gender were found. Results of the study revealed no significant difference for academic class level and gender.

Critical Thinking in Allied Health Professions

Equally important to the healthcare industry, but often overlooked, are the allied health professions. Allied health professionals are “involved with the delivery of health or related services pertaining to the identification, evaluation and prevention of diseases

and disorders; dietary and nutrition services; rehabilitation and health systems management, among others” (Association of Schools of Allied Health Professions (ASAHP), 2009). Allied health professional include dental hygienists, diagnostic medical sonographers, dietitians, radiologic technicians, medical technologists, occupational therapists, health information managers, physical therapists, radiographers, respiratory therapists, and speech language pathologists (ASAHP, 2009). According to Trends, October 2008 issue, “current shortages in allied health occupations are among the highest in the health care field with half of the fastest growing health occupations projected through 2016 in allied health” (ASAHP, 2008, p. 1). Therefore, it is important to learn more about allied health students and their critical thinking skills.

Studies related to critical thinking were found in radiographic technology, occupational therapy, physical therapy, and dental hygiene professions (Bartlett & Cox, 2002; Gosnell, 2010; Inda, 2007; Scaffa & Smith, 2004; Velde, Wittman, & Vos, 2006; Williams et al., 2006; Zettergren & Beckett, 2004) . The majority of these studies evaluated critical thinking skills as an outcome measure based on licensure examination scores.

In the radiologic sciences, most of the literature surrounding critical thinking related to teaching strategies which were thought to influence the development of critical thinking, or discussion of the importance of matching educational preparation with the skills needed in the workforce (Akroyd & Wold, 1996). Similar to other healthcare professions, there is agreement that the ability to engage in appropriate clinical reasoning and sound decision making is a vital skill for radiographers (Adler & Carlton, 2007; Bugg, 1997; Dowd, 1991; Durand, 1999; Martino & Odle, 2006).

Aaron and Haynes (2005) conducted a study to determine whether students' critical thinking abilities improved over the course of a two year radiography curriculum. In this study, the California Critical Thinking Skills Test (CCTST) was administered twice to three cohorts of students in a baccalaureate radiologic sciences program. The test was given at the beginning and end of the program to document developmental gains in critical thinking across the course of the curriculum. Changes in critical thinking among two of the groups were not statistically significant and while changes in the third group were significant, the effect size is small indicating that this change did not indicate a high degree of practical significance (Aaron & Haynes, 2005).

Physical therapy programs have investigated critical thinking in their student population. Zettergren and Beckett (2004) and Bartlett and Cox (2002) both examined changes in critical thinking scores in physical therapy students. Zettergren and Beckett (2004) administered the CCTST to students in the third, fourth, and fifth years of the program. Results revealed a statistically significant difference between the scores of third year and fifth year students ($p = 0.000$) and the scores of students in the fourth and fifth year of the program ($p = 0.05$).

Bartlett and Cox (2002) administered both the CCTST and CCTDI to middle year physical therapy students at the start of the academic year, completion of the year, and after their clinical placements. These researchers found statistically significant improvements in all subscales and both total scores of the CCTST and CCTDI. Age was negatively associated with change on the CCTST, which is an important result since this proposed study will investigate age as a factor based on Health Sciences Reasoning Test (HSRT) performance.

In occupational therapy, Inda (2007) investigated the correlation between clinical reasoning skills and performance on the National Board Certification of Occupational Therapist certification examination. In this study, 35 participants completed the Health Sciences Reasoning Test (HSRT), which assesses critical thinking skills in five key areas- analysis and interpretation, inference, evaluation and explanation, inductive reasoning, and deductive reasoning (Inda, 2007). Pearson product-moment correlation and Spearman's rho analyses indicated significant relationships between certification exam performance on the sub-scales of inductive reasoning ($p = .032/ r_s = .011$), deductive reasoning ($p = .007/r_s = .004$), and analytical reasoning ($p = .001/ r_s = .002$). Total HSRT score was also a significant factor in exam performance ($p = .001/ r_s = .003$) (Inda, 2007). These results indicated students who earned only master's degrees in occupational therapy performed significantly better than those earning combined bachelor's/master's degrees ($p = .000$), scoring an average of 29.15 points higher on the certification exam. Additionally, race, age, grade point average (GPA), geographic location, and fieldwork settings were not significant factors in certification exam performance.

Scaffa and Smith (2004) investigated the effects of level II fieldwork on clinical reasoning in occupational therapy students. The students were measured in a pre-test/post-test design using the Self-Assessment of Clinical Reflection and Reasoning (SACRR) just before the start of fieldwork and immediately after the conclusion of fieldwork. The SACRR is a Likert-style scale based on a hierarchy of 24 behaviors or actions in the reflective process. Scaffa and Smith (2004) found a statistically significant difference in scores on the SACRR, with an increase in clinical reasoning skill post-test,

demonstrating that fieldwork does have a positive impact on a student's clinical reasoning skill.

Velde et al. (2006) investigated the development of critical thinking skills in occupational therapy students. This study assessed whether students would increase their ability to think critically via use of the Guided Reciprocal Peer Questioning (GRPQ) method, which has been identified as a method to increase students' critical thinking test scores and develop the ability to generate questions that demonstrate improved critical thinking. The authors conducted the GRPQ method of teaching to one group of senior occupational therapy students while the other group received a traditional teaching approach (Velde et al., 2006). All students were measured in critical thinking skills via the California Critical Thinking Skills Test (CCTST). Results indicated that there were no significant differences found between the two groups in their CCTST scores (Velde et al., 2006).

Dental hygiene is another important field within the allied health sciences. Williams et al. (2006) utilized the California Critical Thinking Skills Test (CCTST) and California Critical Thinking Disposition Inventory (CCTDI) to evaluate the predictive validity of the tools to both initial clinical dental hygiene performance and scores on the National Board Dental Hygiene Examination (NBDHE). Multiple regression analyses demonstrated that the CCTST scores explained a significant ($p < .05$) proportion of the variance in students' initial clinical reasoning scores, acquired knowledge scores, and faculty ratings (Williams et al., 2003). In the CCTDI, scores were not a significant predictor of any outcome measure related to clinical performance.

In prediction of NBDHE examination performance (Williams et al., 2006), students were tested in the first week of classes upon starting the program in both the CCTST and CCTDI. The subjects were retested at the conclusion of their program. These scores were compared to NBDHE multiple choice and case-based scores. The authors found through regression analyses a significant proportion of variance accounted for ($p < .05$) between CCTST scores and exam performance in both multiple choice and case-based scenario scores (Williams et al., 2006). In the CCTDI scores, no significant predictor was identified from the analysis to the exam scores; thus, the authors concluded that the “CCTST is a good predictor of student performance on high-stakes qualifying examinations” (Williams et al., 2006, p. 536).

Critical Thinking Instruments

One of the greatest challenges to evaluating or improving students’ critical thinking skills lies in obtaining the appropriate instrument to measure these skills. With the ambiguity and lack of consensus on the definition of critical thinking, no one-size-fits all approach exist to selecting an appropriate instrument. Commercially available standardized general critical thinking tests such as the California Critical Thinking Skills Test, the Cornell Critical Thinking Tests, and the Watson-Glaser Critical Thinking Appraisal (Murphy, Conoley, & Impara, 1994) have typically relied on multiple choice responses that test major aspects of critical thinking, including interpretation, analysis, inference, recognition of assumptions, assessing credibility, and detecting fallacies in reasoning (Reed, 2006). None have claimed to test for all aspects of critical thinking. The instruments in Table 1 are used primarily because they have been carefully developed and tested for reliability and validity, and all have been widely used as

measures for testing people's ability to think critically (Facione, 1986). The use of these assessment instruments is facilitated by their ease of grading (machine scoring) and has allowed comparisons among research projects using various models of teaching for critical thinking. While they test how well a student reasons from written material, they cannot assess whether students are able to generate clear, well-supported written or oral arguments, whether they can solve open-ended problems, or whether they have developed dispositions to use critical thinking skills when appropriate (Reed, 2006). Some researchers have suggested that multiple-choice tests are not valid indicators of critical thinking ability because test-takers are not free to determine their own questions or apply their own evaluative criteria (Keeley & Browne, 1986). Several general knowledge essay tests for critical thinking, such as the Ennis-Weir Critical Thinking Essay Test and the International Center for the Assessment of Higher Order Thinking (ICAT) Critical Thinking Essay Test, have been developed as alternatives to multiple-choice formats (Ennis, 1999; Reed, 1998).

The Ennis-Weir Critical Thinking Essay Test (Ennis & Weir, 1985) requires students to read an essay containing numerous reasoning errors and to construct their own response. This standardized, commercially available, essay test of general critical thinking ability provides several advantages over multiple choice tests or instructor-developed essay tests, including student-generated responses, carefully established validity and reliability, and national recognition (Ennis & Weir, 1985).

This study will utilize the commercially available Health Sciences Reasoning Test which is designed specifically for health science professionals, workers, and students. Since 1994, this test "has been used worldwide to predict success, evaluate candidates,

and support professional development and foster a culture of thoughtful problem-solving and decision-making” (Facione, 2011, p. 7). The Table 1 shows each critical thinking test, what it measures and its intended audience.

Table 1

Critical Thinking Instruments

Instruments	Measurement Purpose	Audience
CCTDI or The California Critical Thinking Disposition Inventory	Measures the attributes of truth-seeking, open-mindedness, analyticity, systematicity, inquisitiveness, confidence in reasoning, and cognitive maturity	Community college students, college and university Undergraduate students, graduate and professional school students, adults, and working professionals
CCTST or The California Critical Thinking Skills Test	To assess an individual's or group's critical thinking and reasoning skills To gather data for program evaluation and research on critical thinking skills development	For use with adults at community college, undergraduate, graduate, and professional school levels.
CRA or California Reasoning Appraisal	An intellectually challenging and highly reliable test specifically designed to measure those reasoning skills that are essential to success at the professional and managerial levels	Individuals who are expected to have advanced reasoning skills, that is, those in the top 20% of the general population.
Cornell Critical Thinking Test, Level X	Focuses primarily on the evaluative aspects of critical thinking, such as judging the reliability of reports of observations that other people make	Appropriate for students in Grade 4 through college
Cornell Critical Thinking Test, Level Z	Focuses primarily on the evaluative aspects of critical thinking, such as judging the reliability of reports of observations that other people make	Appropriate for advanced high school students, college students, and adults

(table continues)

Table 1

Critical Thinking Instruments

Instruments	Measurement Purpose	Audience
Ennis-Weir Critical Thinking Essay Test	A diagnostic and research tool for analyzing the effects of a specific curriculum	Designed for secondary and college students
Watson- Glaser Critical Thinking Appraisal	The WGCTA produces a single score based upon the assessment of five critical thinking skills: Inference, Recognition of Assumptions, Deduction, Interpretation, and Evaluation of Arguments	9th grade and above
EMI: Critical Thinking Disposition Inventory	The EMI was developed from the Delphi Report.	High school, college, and adult audiences.
Health Sciences Reasoning Test	Designed specifically for healthcare professionals	College, working professionals.

SOURCE: (Abrams, 2002, p. 23-25)

Summary

Although no single definition of critical thinking exists, efforts have been made toward consensus and acceptable definitions of critical thinking. The lack of single definition has not hampered the research that has been conducted in this area. Many studies regarding critical thinking and gender and critical thinking and age exist; however, results tend to be inclusive and warrant more research.

The critical thinking research in the higher education arena has been broad and extensive, while research on healthcare professional programs research has been limited. Particularly, the allied health professions have relatively few studies regarding the critical

thinking abilities of its population. Consequently, this study will investigate the critical thinking skills of allied health professions, including cytotechnology, dental hygiene, health informatics and information managers, and medical technologists. No other studies have been done that includes looking at multiple programs at once.

Chapter 3

Methodology

This chapter examined the research methods used to evaluate critical thinking skills of allied health students as measured by the Health Sciences Reasoning Test (HSRT). This instrument includes measures of analysis and interpretation, evaluation and explanation, inference, deductive reasoning, inductive reasoning and a total critical thinking score. This chapter includes the following sections: (a) research design, (b) research questions, (c) overview of study participants, (d) instrumentation, (e) procedures, (f) data analysis, and (g) summary.

Research Design

This study employed a non-experimental, descriptive research design. According to Gay, Mills, and Airasian (2006), descriptive research collects data to report on the status or characteristics of the subject of study. A survey methodology was used to investigate the critical thinking skills of allied health students. This study also examined demographic variables to determine their impact on critical thinking skills.

Research Questions

The following research questions guided the study:

1. What is the critical thinking skill level of allied health students at a southeastern university (strong, moderate, or weak)?
2. Are there differences in critical thinking skills based on program of allied health students?
3. Are there differences in critical thinking skills based on gender of allied health students?

4. Are there differences in critical thinking skills between programs taught at different academic levels (baccalaureate, entry-level masters, and masters)?
5. What is the impact of academic level, age, gender, grade point average and program on critical thinking skills of allied health students?

Overview of Study Participants

The participants of the study consisted of students from the cytotechnology, dental hygiene, health informatics and information management, and medical technology students graduating in the class of 2011 from an allied health college in an academic health science center in the southeastern United States. A total of 63 students from cytotechnology, dental hygiene, health informatics and information management, and medical technology were used for the research population for this survey.

The researcher explained the study's goals, objectives, and benefits in an email letter sent to the participants. A copy of the letter is included in Appendix A. The researcher received approval from the University of Tennessee and the University of Memphis Internal Review Boards to conduct the study (Appendices B and C).

Instrument

The Health Sciences Reasoning Test (HSRT) is a commercially available instrument, developed by Noreen and Peter Facione, designed specifically for health science professionals, workers, and students (Insight Assessment, 2011). The instrument has been used in research studies attempting to predict critical thinking skills on professional licensure exams, disposition toward critical thinking among various allied health disciplines, association of critical thinking skills and clinical performance. Additionally, the test has been used to evaluate candidates, support professional development and foster a culture of thoughtful problem solving and decision making. It

is being used worldwide at high ranking health science education programs such as Walla Walla University and The University of North Carolina and at top rated medical centers to measure critical thinking skills and habits of mind in students and practicing professionals (Facione, 2002, p. 5). Questions invite test takers to draw inferences, to make interpretations, to analyze information, to draw warranted inferences, to identify claims and reasons, and to evaluate the quality of arguments. The test developer reports that the HSRT has an overall internal consistency value of .81 with the Kuder Richardson-20 formula, and an overall .81 reliability coefficient (Facione & Facione, 2011, p. 36). The Kuder Richardson-20 is the comparable statistic to Cronbach's alpha.

The instrument consists of 33 multiple choice questions yielding an overall HSRT total score of critical thinking skill level and five sub-scale scores. The total score is a measure of overall critical thinking skills. It evaluates the strength or weakness of one's skill in making reflective, reasoned judgments about what to believe or what to do. Five individual measures capture the following scales: analysis and interpretation, inference, evaluation and explanation, deductive reasoning, and inductive reasoning (Insight Assessment, 2010). Analysis and interpretation are "skills used when determining the precise meaning of a sentence, passage, text, idea, assertion, sign, signal, chart, etc. in a given context and for a given purpose" (Facione & Facione, 2011, p. 12). Inference involves the "ability to draw conclusions based on reasons and evidence" (Facione & Facione, 2011, p. 12). Evaluation and explanation are used to "assess the credibility of claims and the strength or weakness of arguments" (Facione & Facione, 2011, p. 12). Explanation includes providing the reasons, methods, assumptions or rationale for one's beliefs and conclusion. Deductive reasoning is the process which "moves from the

assumed truth of a set of beliefs or premises to a conclusion which follows of necessity” (Facione & Facione, 2011, p. 13). Things which require following rules, definitions, and laws such as algebra, geometry, Sudoku puzzles, and computer programs are examples of deductive reasoning skills. Inductive reasoning is “drawing warranted probabilistic inferences regarding what is most likely true or most likely not true, given the information and the context (Facione & Facione, 2011, p. 13). Scientific disconfirmation of hypotheses uses inductive reasoning. The HSRT was used to assess the students’ level of critical thinking skills.

Procedures

After approval from both IRBs, the researcher contacted Insight Assessment, the commercial vendor that sells the instrument, to obtain access to the product. The researcher requested 40 paper copies of the instrument to administer to the face-to-face students, and 60 online copies of the instrument. Both the online version of the instrument and the paper versions had the same items. The paper version of the instrument was shipped to the researcher two days after payment. After the researcher purchased the instrument from Insight Assessment, a training session was scheduled with Insight Assessment’s training staff to educate the researcher on how to administer the online version of the HSRT as well as the paper version. The training session was conducted via telephone conference and lasted about two hours. A unique account was created to allow the researcher to enter, view, and download data from Insight Assessment’s computer server. All results of the online assessment were automatically linked to the researcher’s unique account.

After training on how to administer the instrument was conducted, the researcher contacted the department chairs of cytotechnology, dental hygiene, health informatics and information management, and medical technology programs to schedule data collection dates. Initially, audiology, speech pathology, physical and occupational therapy were to be included in the sample; however, those students were away on clinical rotations so thus were eliminated from the study. Dates were arranged with dental hygiene and medical technology students to take the paper version of the assessment. Because one program was completely online, health informatics and information management, an online assessment was given to those students. The cytotechnology students were in the process of finishing clinical rotations so the researcher decided they should take the online assessment as well. An email was sent to the online students which explained the study, asked for consent, and provided the instructions for accessing the HSRT. Online test takers were directed to Insight Assessment web page to take the test. To improve participation rates, the researcher sent a follow-up email to online participants one week later, after the initial email request. Dental hygiene and medical technology students who were face-to-face completed the assessment in person during a scheduled data collection date. The results of the face-to-face assessments were entered into the same unique account by the researcher as the online test results. This allowed all test results to be in one place for data manipulation. Completion of both assessments, paper or online, took approximately 45 to 50 minutes. A few students had issues accessing the assessment via email; the issues were quickly resolved through email communication. Data collection began in early April and ended in late May 2011.

Variables

Independent variables captured included age, gender, grade point average (GPA), program, academic level, and educational degree currently seeking. Age was defined as the student's current age. Gender was defined as the student's birth gender and coded 1 = female, and 2 = male. Grade point average was the student's overall GPA prior to being accepted to their respective program. This variable was self-reported and based on a 4.00 scale. Program was defined as the current allied health program the student was enrolled in. Program was coded as 1 = cytotechnology, 2 = dental hygiene, 3 = health informatics and information management, and 4 = medical technology. Academic level was defined as the highest education level obtained prior to acceptance in the current allied health program. This variable was coded as 1 = some college hours, but no degree yet, 2 = associate's degree, 3 = bachelor's degree, 4 = master's degree, 5 = doctoral (terminal) degree, and 6 = other. Degree seeking was defined as the degree to which the student is currently attending school to obtain. This variable was coded as 1 = bachelor's degree, 2 = master's degree, and 3 = entry-level master's degree.

The dependent variables in the study were the HSRT total score, and the five HSRT scale subscores; these were continuous variables. According to the HSRT – Test Manual (2011), total scores ranging from 25 or above represented strong critical thinking skills, scores ranging from 15 to 24 were considered mid-range and represent competence in critical thinking skills in most situations, and scores 14 or below represented fundamental weaknesses in critical thinking skills. According to the HSRT – Test Manual (2011), analysis and interpretation subscales scores of 5 were considered strong and a score of 2 was considered weak. On the subscale of inference, scores of 5 were considered strong

and a score of 2 was considered weak. On the subscale of evaluation and explanation, a score of 5 was considered strong and a score of 2 was considered weak. On the subscale of inductive reasoning, a score of 8 was considered strong and a score of 5 considered weak. On the deductive reasoning scale, a score of 8 was considered strong and a score of 5 was considered weak. Scores were reported if participants responded to at least 60% of the items on the HSRT. In this study, participants completed at least 60% of the items and no missing data was identified.

Data Analysis

Data was entered into a Statistical Package for the Social Sciences (SPSS) spreadsheet program, version 19.0 for Windows, for compilation of descriptive statistics including means, standard deviations and frequency analysis. Inferential statistics utilized included analysis of variance (ANOVA), independent t-tests, and regression analysis. To ensure normality of the dependent variable, total critical thinking score, data were examined using quantile-quantile (Q-Q) plots (Pallant, 2007). Figure 1 presents the results indicating that the HSRT total scores were distributed normally.

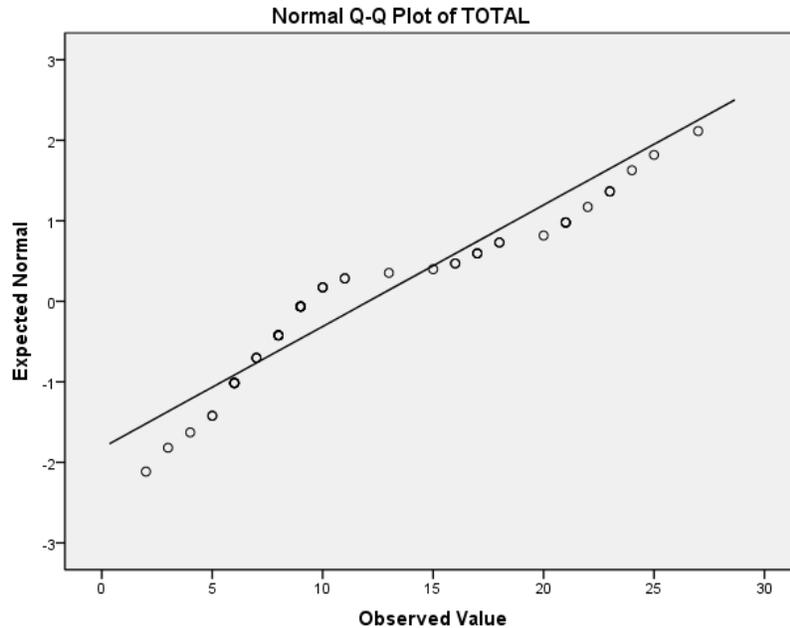


Figure . Q-Q Plot of HSRT total scores

Reliability. Cronbach’s alpha was used to assess the internal reliability or consistency of the scales which made up the total HSRT score. An internal reliability test for the five scales -- analysis and interpretation, inference, and evaluation and explanation, inductive reasoning, and deductive reasoning, was conducted and yielded an alpha value of .85. According to Pallant (2007), an alpha value of .70 or greater is an acceptable measure.

Statistical tests. Frequency analysis was used to answer research question 1, “What is the critical thinking skill level of allied health students at a southeastern university (strong, moderate, or weak)?” Using SPSS 19.0, the dependent variable total critical thinking score was transformed and recoded into a different variable, skill level, to indicate weak, moderate, or strong critical thinking skill level. A total critical thinking score of 14 or below indicated weak critical thinking skill level, total critical thinking

scores of 15 to 24 indicated moderate critical thinking skill level, and total critical thinking skills scores of 25 or above represented strong critical thinking skill level.

Analysis of variance (ANOVA) was used to answer research questions 2, “Are there differences in critical thinking skills based on program of allied health students?” and research question 4, “Are there differences in critical thinking skills between programs taught at different academic levels (baccalaureate, entry-level masters, and masters)?” ANOVA is best utilized when comparing the mean of scores of two groups or more (Pallant, 2007).

An independent sample t-test was used to answer research question 3, “Are there differences in critical thinking skills based on gender of allied health students?” This test was chosen for the gender variable since it was a categorical independent variable of two groups, male and female.

Standard multiple regression was used to answer research question 5, “What is the impact of academic level, age, gender, GPA, and program on critical thinking skills of allied health students?” This method of regression was used because the researcher sought to know how much variance in the dependent variable was explained by the independent variables, academic level, age, gender, GPA, and program. An important step in multiple regression is to ensure that the assumptions of multicollinearity have been met by evaluating the variance inflation factors (VIF). The variance inflation factors were well below 10, which is an acceptable threshold for this assumption. Additionally, an alpha level of .05 was used for statistical confidence.

Summary

This chapter examined the research methods used to evaluate critical thinking skills of cytotechnology, dental hygiene, health informatics and information management, and medical technology allied health students as measure by the Health Sciences Reasoning Test. This instrument measured the overall strength in critical thinking skills used in problem solving and reflective decision making. This study was significant because no other studies of examining multiple allied health programs at once have been published. This chapter included a review of the research design, research questions, overview of study participants, instrumentation, procedures, data analyses, and summary.

Chapter 4

Data Analyses, Findings, and Results

The purpose of the study was to assess the critical thinking skills of cytotechnology, dental hygiene, health informatics and information management, and medical technology Spring 2011 graduates. The instrument used to assess students' critical thinking skills was the Health Sciences Reasoning Test (HSRT). Descriptive statistics were used to describe the critical thinking skill level of allied health students overall. Analysis of variance was used to determine if any differences in HSRT scores between groups of students were statistically significant ($p < .05$). An independent sample t-test was used to determine differences in assessment scores between males and females. Multiple regression was used to determine which variables significantly impact critical thinking skills. The results of the data analyses are reported in three sections of this chapter: (a) Participant Demographics, (b) Statistical Analyses, and (c) Summary.

Participant Demographics

This study was conducted in the southeastern region of the United States using a sample of 63 graduating students from programs in cytotechnology (N = 2), dental hygiene (N = 33), health information and informatics management (N=20), and medical technology (N = 8). A total of 57 students volunteered to take the assessments for a response rate of 90% ($n = 57/63$). The face-to-face sessions resulted in a 91% response rate from dental hygiene, and 75% response rate from medical technology. The email requests asking students to take the online version of the HSRT resulted in a 100% response rate from cytology and a 95% response rate from health informatics and information management.

Results of participant demographics are displayed in Table 2. Participant demographics indicate that five of the participants were male and 52 were female. The participants' ages ranged from 21 to 54 years of ages with an average age of 28.81 years. Academic grade point average, GPA, at entry into their current degree programs for the sample ranged from 2.60 to 4.0 on a 4.0 scale, with a mean of 3.4. Participants were asked about their academic level. Twenty-two (38.6%) participants had some college, but no degree yet, 11 (19.3%) participants had an associate's degree, 21 (36.8%) participants had a bachelor's degree, and three (5.3%) participants had a master's degree. Participants were asked which degree type they were seeking, 42 (73.7%) students were seeking a bachelor's degree, 13 (22.8%) were seeking a master's degree, and two (3.5%) were seeking an entry-level master's degree, Table 3.

Table 2

Demographic Characteristics of Allied Health Students (N = 57)

Participant	Frequency	%
Gender		
Male	5.0	8.8
Female	52.0	91.2
Age		
20-29	63.2	45.6
30-39	28.1	17.5
40-49	0.0	0.0
50-59	5.0	8.8

Table 3

Descriptive Statistics of Participants by Program Type and Degree Seeking

Program Type	n	Degree Seeking		
		Bachelor's	Master's	Entry-Level Master's
Cytology	2	0	0	2
Dental Hygiene	30	28	2	0
HIIM*	19	9	10	0
Medical Technology	6	5	1	0

*Health Informatics and Information Management

Research Questions

Five research questions were examined in this study and the results are reported in the following section.

1. What is the critical thinking skill level of allied health students at a southeastern university (strong, moderate, or weak)?
2. Are there differences in critical thinking skills based on program of allied health students?
3. Are there differences in critical thinking skills based on gender of allied health students?
4. Are there differences in critical thinking skills between programs taught at different academic levels (baccalaureate, entry-level masters, and masters)?

5. What is the impact of academic level, age, gender, grade point average and program on critical thinking skills of allied health students?

Research Question 1

Research question 1 addressed the critical thinking skill level of allied health students at a southeastern university. The HSRT consisted of 33 multiple choice questions with a maximum score of 33. The total scores ranging from 25 or above represented strong critical thinking skills, scores ranging from 15 to 24 are considered mid-range or moderate and represented competence in critical thinking skills in most situations, and scores 14 or below represented fundamental weaknesses in critical thinking skills. Descriptive analysis of critical thinking skill level indicated that 64.9% (n = 37) of allied health sciences students showed weak skills, 31.6% (n = 18) had moderate critical thinking skills and 3.5% (n = 2) had strong critical thinking skills (Table 4).

Table 4

Critical Thinking Skill Level (N = 57)

Skill Level	n	Percent
Weak	37	64.9
Moderate	18	31.6
Strong	2	3.5

On the HSRT, the mean critical thinking score was 12.07 with a range of 2 to 27. As previously mentioned in Chapter 3, on the subscale of analysis and interpretation, scores of 5 were considered strong and a score of 2 was considered weak. On the

subscale of inference, scores of 5 were considered strong and a score of 2 was considered weak. On the subscale of evaluation and explanation, a score of 5 was considered strong and a score of 2 was considered weak. On the subscale of inductive reasoning, a score of 8 was considered strong and a score of 5 considered weak. On the deductive reasoning scale, a score of 8 was considered strong and a score of 5 was considered weak. For these subscales, the critical thinking and analysis and interpretation mean score was 1.84, inference mean score was 1.93, evaluation and explanation mean score was 3.16, inductive reasoning mean score was 5.14, and deductive reasoning mean score was 2.93 (Table 5).

Table 5

Descriptive Statistics of Health Sciences Reasoning Test Scores (N = 57)

Variable	<i>M</i>	<i>SD</i>
Analysis and Interpretation	1.84	1.65
Inference	1.93	12.52
Evaluation and Explanation	3.16	1.53
Inductive Reasoning	5.14	2.17
Deductive Reasoning	2.93	2.58
Total	12.07	6.63

Research Question 2

To test for existence of mean difference in critical thinking score based on allied health program, a one-way analysis of variance was used. Results displayed in Table 6 indicated a statistically significant difference at the $p < .05$ level in critical thinking scores for the different programs: $F(3, 53) = 28.708, p = .00$. Post-hoc analysis using Tukey indicated that the mean score for dental hygiene ($M = 7.73$) was significantly different from cytotechnology ($M = 19.50$), and health informatics and information management (HIIM) ($M = 18.68$). HIIM ($M = 18.68$) was significantly different from dental hygiene ($M = 7.73$) and medical technology ($M = 10.33$). Medical technology ($M = 10.33$) was significantly different from cytotechnology ($M = 19.50$), and HIIM ($M = 18.68$).

Table 6

Results of ANOVA for Critical Thinking Score by Program Type

	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>Sig</i>
Between Groups	1523.914	3	507.971	28.708	.000
Within Groups	937.805	53	17.694		
Total	2461.719	56			

Research Question 3

Research question 3 asked if there were differences in critical thinking skills based on gender of allied health students. There were 52 (91.2%) females and 5 (8.8%) males in the study.

Table 7

Descriptive Statistics of Health Sciences Reasoning Test Scores by Gender

Gender	n	<i>M</i>	<i>SD</i>
Male	5	19.00	6.89
Female	52	11.04	6.27

An independent sample t-test was conducted to compare the critical thinking mean scores between males and females. A significant difference in the mean score for males ($M = 19.0$, $SD = 6.89$) and females, ($M = 11.40$, $SD = 6.27$); $t(55) = (2.56)$, $p = .01$ was identified. The mean score of males, 19.0 was 7.6 points higher than the female mean score of 11.40.

Research Question 4

Research question 4 asked if there were differences in critical thinking skills of graduates of programs taught at different academic levels (baccalaureate, entry-level master's, and master's). Descriptive statistics by academic level displayed in Table 8 show that 42 participants were seeking bachelor's degrees, 13 participants were seeking master's degrees, and two participants were seeking entry-level master's degrees.

Table 8

Descriptive Statistics of Health Sciences Reasoning Test Scores by Academic Level

Academic Level	n (Percentage of total)	<i>M</i>	<i>SD</i>
Bachelor's	42 (73.7%)	9.95	6.08
Master's	13 (22.8%)	17.77	4.20
Entry-Level Master's	2 (3.5%)	19.50	3.53
Total	57	12.07	6.63

To test for existence of mean difference in critical thinking score based on different academic levels, a one-way analysis of variance was used. Results depicted in Table 9 indicated a statistically significant difference at the $p < .05$ level in critical thinking scores for the different academic levels: $F(2, 54) = 11.23, p = .00$. Post hoc analysis using Tukey indicated that the mean score for bachelor's level ($M = 9.95$) was significantly different from master's level ($M = 17.77$), and entry-level master's ($M = 19.50$).

Table 9

Results of ANOVA for Critical Thinking Score by Academic Level

	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>Sig</i>
Between Groups	721.007	2	360.503	11.183	.000
Within Groups	1740.712	54	32.235		
Total	2461.719	56			

Research Question 5

Research question 5 asked about the impact of academic level, age, gender, grade point average, and program on critical thinking skills of allied health students. Multiple regression analyses resulted in a statistically significant model ($df = 5,50$; $F = 9.49$, $p = .000$), reported in Table 10.

Table 10

Results of Regression Model

Model	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>Sig</i>
1 Regression	764.434	5	152.887	4.643	.001
Residual	1646.405	50	32.928		
Total	2410.839	55			

a. Predictors: (Constant), Academic level, GPA, Program, Gender, Age

b. Dependent Variable: TOTAL

The model summary shown in Table 11 indicated that 31.7% of the variance in critical thinking score is explained by the independent variables academic level, GPA, program, gender, and age.

Table 11

Model Summary R-Square Statistics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F change	df1	df2	
1	.563	.317	.249	5.738	.317	4.64	5	50	.001

a. Predictors: (Constant), Academic level, GPA, Program, Gender, Age

Based on the results of Table 12, two independent variables were statistically significant: age ($\beta = .312$, $t = 2.3$, $p = .025$), and program ($\beta = .244$, $t = 2.0$, $p = .025$).

Table 12

Model Summary Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig
1 (Constant)	-11.937	8.531		-1.390	.168
Age	.228	.099	.312	2.310	.025
Academic Level	.694	.882	.104	.787	.435
GPA	1.970	2.231	.105	.883	.381

(table continues)

Table 12

Model Summary Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig
Gender	3.585	2.887	.156	1.242	.220
Program	1.287	1.086	.244	2.013	.025

a. Dependent Variable: TOTAL HSRT Score

Summary

In conclusion, this study of critical thinking skills among allied students yielded the following results. Descriptive frequency statistics indicated that 64.9% of allied health sciences participants in the study had weak critical thinking skills, 31.6% of the participants had moderate critical thinking skills and 3.5% of the participants had strong critical thinking skills. Additionally, an independent t-test indicated that male participants scored higher on the HSRT than females. ANOVA analysis indicated differences in critical thinking based on academic level. Bachelor participants' critical thinking skills were lower than master's and entry-level master's participants. Surprisingly, entry level master's students scored higher than master's level students. This could be a result of the small sample of entry-level students. Finally, multiple regression results indicated that 31.7% of the variance in total critical thinking skills can be explained by gender, age, program, GPA, and academic level. Only age and program were statistically significant. While the results of this study cannot be generalized to all

college students, it contributes to the body of research concerning the importance of improving critical thinking skills among college students.

Chapter 5

Summary, Implications and Recommendations

This study assessed the critical thinking skills of cytotechnology, dental hygiene, health informatics and information management, and medical technology allied health students as measured by the Health Sciences Reasoning Test (HSRT). The HSRT measures critical thinking and critical reasoning skills of healthcare professionals. This research was significant because research in the critical thinking skills of allied health professions lags behind those of mainstream healthcare professions like nursing, and medicine. This study is also the first study to investigate multiple allied health disciplines at a single time. This chapter includes the summary, limitations, implications and recommendations for further research.

Summary

The primary purpose of this study was to determine the critical thinking skill level of allied health students at a southeastern university as measured by the Health Sciences Reasoning Test. Additionally, the study sought to determine if critical thinking skills level differed by gender, age, grade point average, program type, or academic level. Spring 2011 graduating seniors in the allied health programs of cytotechnology, dental hygiene, health informatics and information management, and medical technology served as the convenience sample for the study.

Descriptive frequency statistics indicated that 64.9% of allied health sciences participants in the study had weak critical thinking skills, 31.6% of the participants had moderate critical thinking skills and 3.5% of the participants had strong critical thinking skills. This finding is consistent with Arum and Roksa's (2011) study which indicated

that students' critical thinking and critical reasoning skills were relatively small or non-existent.

This study found statistically significant differences in critical thinking based on program type. Dental hygiene mean scores ($M = 7.73$) was significantly different from cytotechnology ($M = 19.50$), and health informatics and information management (HIIM) ($M = 18.68$). Health informatics and information management ($M = 18.68$) was significantly different from dental hygiene ($M = 7.73$) and medical technology ($M = 10.33$). Medical technology ($M = 10.33$) was significantly different from cytotechnology ($M = 19.50$), and HIIM ($M = 18.68$). No other studies investigating multiple programs at once have been published to allow for comparison.

Additionally, this study found statistically significant differences in critical thinking based on academic level. Bachelor's participants' critical thinking skills were lower than master's and entry-level master's participants. This result is consistent with findings in a nursing study where Fero et al. (2009) found significant differences between the development of critical thinking among graduates of diploma, associate and baccalaureate educational programs. Fero et al. (2009) found that those prepared at the baccalaureate level demonstrated higher levels of critical thinking ability than those at the diploma, or associate level. King and Kitchener (1994) also found that more formal education is a powerful predictor of critical and reflective thinking.

This study found a significant difference in male and female participants, $p < .05$. This finding is consistent with results from Wilson (1989) and Walsh (1996) who found that gender was a significant predictor of critical thinking skills. However, Clayor (1997)

and Thompson (2001) found gender to be independent of critical thinking skills. With such a small sample of male students, more research is still needed in this area.

Limitations

There are several limitations to the study. First, the study is limited to one academic health science center geographically located in the southeastern United States which reduces the generalizability of the results. While results of this study may be typical for allied health students at this location, they may not be indicative of allied health students elsewhere in the region or in other regions of the United States. Second, participants were limited to only those students enrolled and expected to graduate in the Spring of 2011 so the demographics and backgrounds of these participants may not be typical of those expected to graduate at another time. This study was also constrained by data being collected at one collection point -- that is, upon exit -- in the students' academic career. Data was captured close to the time of graduation and participants may have been focused on graduation rather than an assessment.

Implications

Recognizing the importance of critical thinking, universities and colleges are incorporating critical thinking assessments and outcome measures of critical thinking throughout their academic programs. The Critical Thinking Foundation and the critical thinking community continues to stress the importance that critical thinking plays in one's ability to succeed in today's workplace. The results of this study could help inform college administrators, deans, program directors, and department chairs, as well as faculty, on the extent to which critical thinking is demonstrated in their program graduates and serve as the starting point for critical thinking discussions to occur.

For deans and college administrators, the results of the study provide support to introduce programs to improve critical thinking skills. Several universities such as George Mason University, University of Tennessee, Chattanooga, and El Paso Community College have instituted critical thinking programs in their institutions to provide an avenue for students and faculty to focus on critical thinking outcome measures. These avenues include, but are not limited to, programs such as critical thinking across the curriculum, critical thinking across the disciplines, and specific courses on critical thinking.

In addition, deans and administrators should collaborate with other universities to develop critical thinking instruments, and measure students' critical thinking skills. Several universities have received funding from the National Science Foundation to collaborate with other universities to develop critical thinking instruments such as the critical thinking assessment test (CAT) (Tennessee Tech University, 2011). Not only should universities collaborate with other universities, but there is perhaps, other opportunities to collaborate with various centers and foundations for teaching excellence to develop programs to enhance critical thinking skills of allied health students.

For program directors and department chairs in the allied health areas, the ability of students to pass national board examinations is an important outcome measure. However, equally important is the ability of allied health students to possess adequate critical thinking and reasoning skills. Since allied health students will begin professional practice of administering care to patients or providing important supportive services, the ability to think critically and solve complex problems is an essential job skill. Therefore, program directors and department chairs should assess students' critical thinking skills

upon entering, mid-way through, and upon exiting their respective programs and make necessary changes to ensure students are graduating with adequate critical thinking skills for the 21st century workplace. During orientation, students should be introduced to the concept of critical thinking, why it is important, how it is beneficial, and that it is an expectation of employers. Furthermore, a critical thinking assessment upon entering their respective programs should be given to the students to establish a critical thinking baseline. Mid-way through their respective programs, students' critical thinking skills should be assessed to determine if any gains in critical thinking ability are made. Additionally, this will provide a means for students to assess their strong and/or weak areas and focus on those. Upon exiting their respective programs, students' critical thinking skills should be assessed to evaluate if any significant changes or improvements in critical thinking ability were made over time.

One main problem with critical thinking has been defining what it is. Faculty and instructors should learn more about critical thinking and how to incorporate it into curriculum of each program. Having faculty and instructors attend workshops and training sessions to ensure everyone is striving for the same goal and having a systematic approach to teaching critical thinking is invaluable. Defining what critical thinking means at a specific university and integrating critical thinking requirements in faculty training is essential. For example, are faculty going to focus on Blooms taxonomy of knowledge, understanding, application, analysis, synthesis, and evaluation or are faculty going to focus on the APA model of analysis, interpretation, evaluation, explanation, deductive reasoning, inductive reasoning, and inference or a combination of both? Creative

institutions of higher learning have proposed their own models of critical thinking and incorporated them into their curriculum.

There is no “magic trick or quick fix” instructional model that instructors can apply in a few courses to increase critical thinking skill; rather it is the careful integration of deep thinking and thought provoking assignments of educators that is essential for developing critical thinking skills of students. A few strategies used to foster critical thinking skills are – evaluating alternatives to a problem, identifying credible sources, organizing an essay, predicting what will happen next, defending an argument, and self-evaluating the learning process through reflective analysis (San Jose State University, 2011). Additionally, faculty should include specific content to allow students to integrate The Partnership for 21st Century Critical Thinking Skills into assignments.

These skills include:

using system thinking to analyze how parts of a whole interact with each other to produce overall outcomes in complex systems, make judgments and decisions by effectively analyzing and evaluating evidence, arguments, claims and beliefs, analyzing and evaluating major alternative points of view, synthesizing and making connections between information and arguments, interpreting information and drawing conclusions based on the best analysis, reflecting critically on learning experiences and processes, and solving problems by using different kinds of non-familiar problems in both conventional and innovative ways, and identifying and asking significant questions that clarify various points of view and lead to better solutions. (Partnership for 21st century skills, 2010)

Recommendations

As a result of this study, several remaining questions emerged and were identified as future research possibilities. Critical thinking research should be expanded to other allied health programs throughout the U.S. and include longitudinal studies to identify if critical thinking skills change during the academic years. In dental hygiene, Williams et al. (2006) found a correlation between critical thinking and success on national board examinations. A future research study could examine other allied health disciplines to identify if a relationship between critical thinking skills and pass-rate on their respective disciplines' national board examinations exists. Further analysis could identify which factors have the greatest impact on success rates.

Most allied health programs have a selective admission process that includes a review of grades, recommendation letters, leadership ability and personal interviews. Based on the findings of this study, GPA was not a significant factor in critical thinking skill level. Perhaps reviewing the selective admission criteria to include assessing students' critical thinking skills will improve program outcomes.

The HSRT is only one assessment tool used to measure critical thinking skill level. A future research study could evaluate the differences between students' critical thinking skills using the Watson-Glaser Critical Thinking Assessment and the Health Sciences Reasoning Test. However, it should be noted that some argue (Fawkes et al. , 2003; Keely & Brown, 1986) that it is difficult to capture critical thinking ability using multiple choice instruments and more qualitative measures should be included in the research design of such a study.

Finally, a future research study to assess students' use of technology and critical thinking skill level should be examined. Research has shown that today's students use more technology today than ever before; however, is it adding to their critical thinking ability? Therefore, a study to assess students' critical thinking skills in a digital environment would provide insight into this question.

References

- Abrams, X.X. (2002). Critical thinking: A literature review. Retrieved from http://aec.ifas.ufl.edu/abrams/step/critical_litreview.pdf
- Adler, A.M., & Carlton, R. R. (2007). *Introduction to radiologic sciences and patient care*. (4th ed.) St. Louis, MO: Elsevier.
- Akroyd, D., & Wold, B. (1996). The importance of selected workplace skill and radiographers' ability to perform them: Implications for education and practice. *Radiologic Science and Education*, 3(1), 6-23.
- Albitz, R. S. (2007). The what and who of information literacy and critical thinking in higher education. *Portal: Libraries and the Academy*, 7(1), 97-109.
- American Philosophical Association. (1990). Critical thinking: A statement of expert consensus for the purposes of educational assessment and instruction. (ERIC Document Reproduction Service ED 315-423)
- Arum, R., & Roksa, J. (2011). *Academically adrift: Limited learning on college campuses*. Chicago: University of Chicago Press.
- Association of Schools of Allied Health Professions. (2011). Allied health professions definitions. Retrieved from <http://www.asahp.org/definition.htm>
- Association of Schools of Allied Health Professions. (2011). Trends (2008). Retrieved from <http://www.asahp.org/trends/2008/October.pdf>
- Bartlett, D. J., & Cox, P. D. (2002). Measuring change in students critical thinking ability: Implications for healthcare education. *Journal of Allied Health*, (31), 64-69.

- Baugh, N. G., & Mellott, K.G. (1998). Clinical concept mapping as preparation for student nurses' clinical experiences. *Journal of Nurse Education, 23*, 35-41.
- Baxter-Magolda, M. (1992). *Knowing and reasoning in college: Gender-related patterns in students' intellectual development*. San Francisco: Jossey-Bass.
- Beitz, J. M. (1998). Education for health promotion and disease prevention: convince them, don't confuse them. *Ostomy Wound Manage, 44*(3A Suppl), 71S-76S.
- Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice, and mind*. New York: Basic Books.
- Bers, T. (2000). Assessing the achievement of general education objectives: A college-wide approach. *The Journal of General Education, 49*(3), 182-210.
- Boydjian-Samawi, Z. (2006). The effect of concept mapping on critical thinking skills and dispositions of junior and senior baccalaureate nursing students. Retrieved from <http://cmc.ihmc.us/cmc2006Papers/cmc2006-p159.pdf>
- Brookfield, S.F. (1997). Assessing critical thinking. *New Directions for Adult and Continuing Education, 75*, 17-29. Doi:10.1002/ace.7502
- Bugg, N. (1997). Teaching critical thinking skills. *Radiologic Technology, (65)*5, 433-434.
- Chan, N.-M., Ho, I. T., & Ku, K. Y. L. (2011). Epistemic beliefs and critical thinking of chinese students. *Learning and Individual Differences, 21*(1), 67-77.
- Chu, H., & Hinton, B. E. (2001, February). Factors affecting student completion in a distance learning mediated HRD baccalaureate program. *Distance learning*. Symposium conducted at the meeting of the Academy of Human Resource

Development, Tulsa, OK. Retrieved from

<http://www.eric.ed.gov/PDFS/ED453410.pdf>

Clayton, L.H. (2006). Concept mapping: an effective, active teaching-learning method.

Nurse Educators Perspectives, 27(4), 197-203.

Clayton, K. L. (1997). *The development and validation of an adult medical nursing critical thinking instrument (andragogy)*. Indiana: Indiana University.

Coker, P. (2010). Effects of an experiential learning program on the clinical reasoning and critical thinking skills of occupational therapy students. *Journal of Allied Health*, 39(4), 280-286.

Colucciello, M. L. (1997). Critical thinking skills and dispositions of baccalaureate nursing students: A conceptual model for evaluation.

Journal of Professional Nursing, 13(4), 236-245.

Colucciello, M. L. (1999). Relationships between critical thinking dispositions and learning styles [Electronic Version]. *Journal of Professional Nursing*, 15(5), 294-301.

Corrallo, S. (1991). Critical concerns in assessing selected higher-order thinking and communication skills of college graduates. *Assessment Update*, 3(6), 5-6.

Crabtree, J. L., Royeen, C. B., & Mu, K. (2001). The effects of learning through discussion in a course in occupational therapy: a search for deep learning. *Journal of Allied Health*, 30(4), 243-247.

Daley, B. J. (2002). Facilitating learning with adult students through concept mapping.

Journal of Continuing Higher Education, 50(1), 21-31.

Daley, B. J., Shaw, C. R., Balistrieri, T., Glasenapp, K., & Piacentine, L. (1999).

- Concept maps: A strategy to teach and evaluate critical thinking. *Journal of Nursing Education*, 38, 42-47.
- Damji, S., Dell'Anno, M., McGrath, M., & Warden, J. (2001). *What is critical thinking and how can it be promoted by adult educators?* Retrieved from <http://fcis.oise.utoronto.ca/~dschugurensky/faqs/qa10.html>
- Delany, C., & Watkin, D. (2009). A study of critical reflection in health professional education: Learning where others are coming from. *Advances in Health Sciences Education*, 14(3), 411-429.
- Del Bueno, D. (2005). A crisis in critical thinking. *Nursing Education Perspectives*, 26(5), 278-282.
- Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: D.C. Heath.
- Dowd, S.B. (1991). Teaching strategies to foster critical thinking. *Radiologic Technology*, 62(5), 374-378.
- Durand, K. S. (1999). *Critical thinking: Developing skills in radiography*. Philadelphia: F. A. Davis Co.
- Eison, J., & Moore, J. (1980). *Learning styles and attitudes of traditional age and adult students*. Paper presented at the 88th Annual Meeting of the American Psychological Association, Montreal, Canada.
- Elam, J. H. (2001). *Critical thinking skills and disposition of first-year and third-year optometry students* (Doctoral dissertation). The University of Memphis, United States -- Tennessee. Retrieved from Dissertations & Theses @ University of Memphis. (Publication No. AAT 3003740).

- Ennis, R.H. (1962). A concept of critical thinking. *Harvard Education Review*, 32(1), 81-111.
- Ennis, R.H., Millman, J., & Tomki, T. N. (1985). *Cornell critical thinking test level x and level z – manual*. Pacific Grove, CA: Midwest Publications.
- Erwin, T. D., & Sebrell, K. W. (2003). Assessment of critical thinking: ETS's tasks in critical thinking. *Journal of General Education*, 52(1), 50-70.
- Facione, N. C., & Facione, P. A. (1994). *The california critical thinking skills test and the national league for nursing accreditation requirement in critical thinking*. (ERIC Document Reproduction Service No. ED 380509)
- Facione, N. C., & Facione, P. A. (1996). Externalizing the critical thinking in knowledge development and clinical judgment. *Nursing Outlook*, 44, 129-136.
- Facione, N. C., & Facione, P. A. (2005). *The health sciences reasoning test*. Millbrae, CA: The California Academic Press.
- Facione, N.C., & Facione, P. A. (2011). *The health sciences reasoning test manual 2011 edition*. Millbrae, CA: The California Academic Press.
- Facione, P. A. (1990). *The Delphi Report. Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. (ERIC Document Reproduction Service No. TM 014423)
- Facione, P. A. (2000). *The test of everyday reasoning*. Millbrae, CA: The California Academic Press.
- Facione, P. A., Giancarlo, C. A., Facione, N. C., & Gainen, J. (1995). The disposition toward critical thinking. *Journal of General Education*, 44, 1-25.

- Farrand, P., Hussain, F., & Hennessy, E. (2002). The efficacy of the mind map study technique. *Medical Education, 36*(5), 426-431.
- Fawkes, D., Adajian, T., Flage, D., Hoeltzel, S., Knorpp, B., O'Meara, B., & Weber, D. (2003). Examining the exam: A critical look at the Watson-Glaser Critical Thinking Appraisal exam. *Inquiry, 21*(3), 31-46.
- Fero, L. J., Witsberger, C. M., Wesmiller, S. W., Zullo, T. G., & Hoffman, L. A. (2009). Critical thinking ability of new graduate and experienced nurses. *Journal of Advanced Nursing, 65*(1), 139-148.
- Fullerton, J. T., & Ingle, H. T. (2003). Evaluation strategies for midwifery education linked to digital media and distance delivery technology. *Journal of Midwifery Womens Health, 48*(6), 426-436. doi: 10.1016/j.jmwh.2003.08.009
- Gay, L. R., Mills, G.E., & Airasian, P. W. (2006). *Educational research: Competencies for analysis and applications* (8th ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.
- Gellin, A. (2003). The effect of undergraduate student involvement on critical thinking: A meta-analysis of the literature 1991-2000. *Journal of College Student Development, 44*(6), 746-762.
- Giancarlo, C. A., & Facione, P. A. (2001). A look across four years at the disposition toward critical thinking among undergraduate students. *The Journal of General Education, 50*(1), 29-55. doi: 10.1353/jge.2001.0004
- Gibbs, G. (Ed.). (1994). *Improving student learning: Theory and practice*. Oxford, England: Oxford Centre for Staff Development, Oxford Brookes University.

- Gibson, C. (1995). Critical thinking: Implications for instruction. *Renaissance Quarterly*, 35, 27.
- Halpern, D.F. (1993). Assessing the effectiveness of critical thinking instruction. *Journal of General Education*, (42)4, 238-254.
- Halpern, D.F. (1997). Students need reality checks. *Education Digest*, 63, 24-26.
- Halpern, D.F. (2003). *Thinking critically about critical thinking*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Harris, L. M., Adamson, B. J., Reed, V., & Hunt, A. E. (1998). Impact of curricular change in an undergraduate program for speech pathologists on perceived preparedness for the workplace. *Journal of Allied Health*, 27(4), 221-227.
- Hart Research Association. (2010). Raising the bar: Employers' views on college learning in the wake of the economic downturn. Retrieved from http://www.aacu.org/leap/documents/2009_EmployerSurvey.pdf
- Hojat, M., Borenstein, B. D., & Veloski, J. J. (1988). Cognitive and noncognitive factors in predicting the clinical performance of medical school graduates. *Journal of Medical Education*, 63, 323-325
- Insight Assessment. (2006). The health sciences reasoning test. Retrieved from http://www.insightassessment.com/Products/Critical-Thinking-Skills-Tests/Health-Science-Reasoning-Test-HSRT/node_383
- Irvine L. M. (1995). Can concept mapping be used to promote meaningful learning in nurse education? *Journal of Advanced Nursing*, 21, 1175-1179.
- Jensen, G. M., & Saylor, C. (1994). Portfolios and professional development in the health professions. *Evaluation and the Health Professions*, 17(3), 344-357.

- Karakas, S. L. (2010). Creative and critical thinking in the arts and sciences: Some examples of congruence. *Forum on Public Policy Online*, Retrieved from <http://forumonpublicpolicy.com/spring2010.vol2010/spring2010archive/karakas.pdf>
- Keeley, S. M., & Browne, M. (1986). How college seniors operationalize critical thinking behavior. *College Student Journal*, 20, 389-395.
- King, A. (1990). Enhancing peer interaction and learning in the classroom through reciprocal questioning. *American Educational Research Journal*, 27(4), 664-687.
- King, A. (1994). Inquiry as a tool in critical thinking. In D. F. Halpern (Ed.) *Changing college classrooms: New teaching and learning strategies for an increasingly complex world* (pp. 13-38). San Francisco, CA: Jossey-Bass.
- King, P., & Kitchener, K. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. San Francisco, CA: Jossey-Bass.
- Kuhn, D. (1992). Thinking as argument. *Harvard Educational Review*, 62(2), 155-178.
- Kuiper, R. (2002). Enhancing metacognition through the reflective use of self-regulated learning strategies. *Journal of Continuing Education in Nursing*, 33(2), 78-87.
- Kurfiss, J. (1988). *Critical thinking theory, research, practice, and possibilities*. ASHE-ERIC Higher Education Report No. 2, Washington, DC: ASHE.
- Lampert, N. (2007). Critical thinking dispositions as an outcome of undergraduate education. *The Journal of General Education*, 56(1), 17-33.
- Learning in Higher Education. (2011). Core findings. Retrieved from http://highered.ssrc.org/?page_id=33

- Luckowski, A. (2003). Concept mapping as a critical thinking tool for nurse educators. *Journal for Nurses in Staff Development, 19*(5), 228-233.
- Lun, V. M., Fischer, R., & Ward, C. (2010). Exploring cultural differences in critical thinking: Is it about my thinking style or the language I speak? *Learning and Individual Differences, 20*(6), 604-616.
- Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning, 5*(2), 137-156.
- Martino, S., & Odle, T. (2006). New skills acquisition. *Radiologic Technology, 78*(2), 97-100.
- May, B.A., Edell, V., Butell, S. Doughty, J., & Langford, C. (1999). Critical thinking and clinical competence: A study of the their relationship in BSN seniors. *Journal of Nursing Education, 38*(3), 100-110.
- McCarthy, P., Schuster, P., Zehr, P., & McDoughal, D. (1999). Evaluation of critical thinking in a baccalaureate nursing program. *Journal of Nursing Education, 38*(3), 142-144.
- Mendenhall, A., & Johnson, T. E. (2010). Fostering the development of critical thinking skills, and reading comprehension of undergraduates using a web 2.0 tool coupled with a learning system. *Interactive Learning Environments, 18*(3), 263-276.
- Mezirow, J., & Associates. (1990). *Fostering critical reflection in adulthood: A guide to transformative and emancipatory learning*. San Francisco, CA: Jossey-Bass.
- Molaison, E. F., Taylor, K. A., Erickson, D., & Connell, C. L. (2009). The use and perceptions of concept mapping as a learning tool by dietetic internship students and preceptors. *Journal of Allied Health, 38*(3), e97-103.

- Moore, B., & Stanley, T. (2010). Critical thinking and formative assessments: Increasing the rigor in your classroom, *Eye on Education*. Retrieved from http://www.eyoneducation.com/bookstore/client/client_pages/samplechapters/7126-3.pdf
- Moulding, N. T. (2010). Intelligent design: Student perceptions of teaching and learning in large social work classes. *Higher Education Research and Development*, 29(2), 151-165.
- Murphy, L.L., Conoley, J.C., & Impara, J.C. (Eds.) (1994). *Tests in print* (4th ed.). Lincoln, NE: Buros Institute of Mental Measurements.
- Norris, S.P. (1985). Synthesis of research on critical thinking. *Educational Leadership*, 42 (8), 40-45.
- O'Dell, B., Mai, J., Thiele, A., Priest, A., & Salamon, K. T. (2009). The hot seat: Challenging critical thinking and problem solving skills in physical therapist students. *Journal of Allied Health Sciences & Practice*, 7(1), 10.
- Pallant, J. (2007). *SPSS Survival Manual: A step by step guide to data analysis* (3rd ed). England: Open University Press.
- Partnership for 21st century skills. (2010). Critical thinking and problem solving. Retrieved from http://route21.p21.org/images/stories/epapers/skills_foundations_final.pdf
- Pascarella, E. T. (1989). The development of critical thinking: Does college make a difference? *Journal of College Student Development*, 30, 19-26.

- Pascarella, E.T., & Terenzini, P. (1991). Studying college students in the 21st century: Meeting new challenges. *The Review of Higher Education*, (21)2, 151-165.
Doi:10.1353/rhe.1997.0023
- Perry, W. G. (1970). *Forms of intellectual and ethical development in the college years: A scheme*. New York: Holt, Rinehart, and Winston
- Peters, M. (2000). Does constructivist epistemology have a place in nurse education? *Journal of Nursing Education*, 39(4), 166-170.
- Profetto-McGrath, J. (2005). Critical thinking and evidence-based practice. *Journal of Professional Nursing*, 21(6), 364-371.
- Profetto-McGrath, J., Hesketh, K.L., Land, S., & Estabrooks, C.A. (2003). A study of critical thinking research utilization among nurses. *Western Journal of Nursing Research*, 25(3), 22-37.
- Raymond, C.L., & Profetto-McGrath, J. (2005). Nurse educators' critical thinking: Reflection and measurement. *Nurse Education in Practice*, 5(4), 209-217.
- Reed, J. (1998). *Effect of a model for critical thinking on student achievement in primary source document analysis and interpretation, argumentative reasoning, critical thinking dispositions, and history content in a community college history course* (Doctoral dissertation). Retrieved from <http://www.criticalthinking.org/pages/effect-of-a-model-for-critical-thinking-on-student-achievement/596>
- Reed, S. L., & Stavreva, K. (2006). Layering knowledge: Information literacy as critical thinking in the literature classroom. *Pedagogy*, 6(3), 435-452.

- Rivers, W. (2001). Autonomy at all costs: An ethnography of metacognitive self-assessment and self-management among experienced language learners. *Modern Language Journal*, 85(2), 279-290.
- Roberts, C. M., Sucher, K., Perrin, D. G., & Rodriguez, S. (1995). Concept mapping: an effective instructional strategy for diet therapy. *Journal of the American Dietetic Association*, 95(8), 908-911.
- Rudd, R. M., Baker, D., & Hoover, T. (2000). Undergraduate agriculture student learning styles and critical thinking abilities: Is there a relationship? *Journal of Agricultural Education*, 41(3), 2-12.
- San Jose State University. (2011). Mission critical. Retrieved from www.sjsu.edu/depts/itl/graphics/main.html
- Schamber, J. F., & Mahoney, S. L. (2006). Assessing and improving the quality of group critical thinking exhibited in the final projects of collaborative learning groups. *The Journal of General Education*, 55(2), 103-137.
- Shepelak, N. J., Curry-Jackson, A., & Vernon, L. M. (1992). Critical thinking in introductory sociology classes: A program of implementation and evaluation. *Teaching Sociology*, 20(1), 18-27.
- Shin, K. R., Ha, J. Y., & Kim, K. H. (2005). A longitudinal study of critical thinking dispositions and critical thinking skills in baccalaureate nursing students. *Taehan Kanho Hakhoe Chi*, 35(2), 382-389.
- Simpson, A. (2010). Integrating technology with literacy: Using teacher-guided collaborative online learning to encourage critical thinking. *Research in Learning Technology*, 18(2), 119-131.

- Stadt, R., & Ruhland, S. (1995). Critical-thinking abilities of radiologic science students. *Radiologic Technology*, 67(1), 24-28.
- Steinberg, J. (2011, January 17). How much do college students learn, and study? *The New York Times*. Retrieved from <http://thechoice.blogs.nytimes.com/2011/01/17/academically-adrift/>
- Tennessee Tech University. (2011). Critical thinking assessment test. Retrieved from <http://www.tntech.edu/cat/home/>
- Titterington, L. C. (2007). Case studies in pathophysiology: the development and evaluation of an interactive online learning environment to develop higher order thinking and argumentation. Ph.D., Ohio State University. Retrieved from <http://etd.ohiolink.edu/view.cgi/Titterington%20Lynda%20Carol.pdf?osu1196183110>
- Torres, R. M., & Cano, J. (1995). Critical thinking as influenced by learning style. *Journal of Agricultural Education*, 36(4), 55-62.
- Tsui, L. (2001). Faculty attitudes and the development of students' critical thinking. *The Journal of General Education*, 50(1), 1-28.
- Tsui, L. (2002). Fostering critical thinking through effective pedagogy: Evidence from four institutional case studies. *The Journal of Higher Education*, 73(6), 740-763.
- Vahradian, S. (1995). Critical-thinking strategies for the EMS classroom. *Journal of Emergency Medical Services*, 20(3), 149.
- Velde, B., Wittman, P.P., & Vos, P. (2006). Development of critical thinking in occupational therapy students. *Occupational Therapy International*, (13)1, 49-60.
Doi: 10.1002/oti.20

- Walsh, C.M. (1996). *Critical thinking disposition of university student in practice disciplines (nursing, education, and business) and non-practice disciplines (English, history and psychology): An exploratory study*. College Park, MD, University of Maryland.
- Wang, Q., & Woo, H. (2010). Investigating students' critical thinking in weblogs: an exploratory study in a Singapore secondary school. *Asia Pacific Education Review, 11*(4), 541-551. doi: 10.1007/s12564-010-9101-5
- Weiler, A. (2005). Information-seeking behavior in generation Y students: Motivation, critical thinking, and learning theory. *The Journal of Academic Librarianship, 31*(1), 46-53. doi: 10.1016/j.acalib.2004.09.009
- Wheeler, L.A., & Collins, S.K.R. (2003). The influence of concept mapping on critical thinking in baccalaureate nursing students. *Journal of Professional Nursing, 19*, 339-346.
- Williams, K.B., Glasnapp, D.R., Tilliss, T., Osborn, J., Wilkins, K., Mitchell, S., Kershbaum, W., & Schmidt, C. (2003). Predictive validity of critical thinking skills for initial clinical dental hygiene performance. *Journal of Dental Education, (67)*, 1180-1192.
- Williams, K. B., Schmidt, C., Tilliss, T., Wilkins, K., & Glasnapp, D.R. (2006). Predictive validity of critical thinking skills and disposition for the national board dental hygiene examination: A preliminary investigation. *Journal Dental Education, 70*, 536-544.
- Williams, R.L., & Worth, S.L. (2001). The relationship of critical thinking to success in college. *Inquiry: Critical Thinking Across the Disciplines, 21*(1), 5-16.

- Willingham, D. T. (2007). Critical thinking: Why is it so hard to teach? *American Educator*, (31)2, 8-19.
- Wilson, K. D. (1989). *Predictors of proficiency in critical thinking for college freshmen*. Bozeman, MT: Montana State University.
- Winch, C. (2004). Developing critical rationality as a pedagogical aim. *Journal of Philosophy of Education*, 38(3), 467-484.
- Wlodkowski, R. J, Mauldin, J.E., & Gahn, S.W., (2001). *Learning in the fast lane: Adult learners' perspective and success in accelerated college programs*. Indianapolis: Lumina Foundation for Education.
- Zettergren, K. K., & Beckett, R. (2004). Changes in critical thinking scores: An examination of one group of physical therapy students. *Journal of Physical Therapy Education*, 18(2), 73-79.
- Zori, S., & Morrison, B. (2009). Critical thinking in nurse managers. *Nursing Economics*, 27(2), 75-80.

Appendix A

Assessing Critical Thinking Skills of Allied Health Students

Dear Prospective Participant:

I am a doctoral candidate at the University of Memphis. I am conducting research on critical thinking skills in allied health students. Because you are a student in an allied health program, you have been asked to take part in this research study. The purpose of this study is to assess the critical thinking skills of allied health students. The research study involves answering 33 multiple choice questions to measure your critical thinking skill level. The assessment will take approximately 50 minutes to complete. Please answer all questions to the best of your ability. Do not skip questions.

Participating in the study allows you to identify critical thinking areas where you have strong skills as well as areas where you need to improve. There are no risks involved in completing the assessment. Your individual scores will not be shared with anyone, specifically program directors or department chairs. A copy of your individual score is available to you upon request.

Participation in the study is voluntary and there is no penalty if you decide not to participate. However, your participation may help other students in the allied health professions. Please be assured that your responses will be held in strict confidence. The results will be reported aggregately without reference to individuals.

You must be 18 years of age or older to take part in this research study. Your willingness to participate in the study serves as informed consent.

Thank you in advance for your time and attention.
Marcia Sharp, MBA, RHIA
UTHSC, (901)448-6486, msharp@uthsc.edu

Prepared: March 2, 2011

 IRB NUMBER: 11-01227-XM
IRB APPROVAL DATE: 3/8/2011

Appendix B

THE UNIVERSITY OF TENNESSEE
Health Science Center



Institutional Review Board
910 Madison Avenue, Suite 600
Memphis, TN 38163
Tel: (901) 448-4824

8 March 2011

Marcia Y Sharp, MBA, RHIA
UTHSC - COAHS - Health Informatics & Info Mgmt
518 920 Madison Building
920 Madison Avenue
Memphis, TN 38163

Re: 11-01227-XM
Study Title: Critical Thinking in Allied Health Students

Dear Dr. Sharp:

The Administrative Section of the UTHSC Institutional Review Board (IRB) has received your written acceptance of and/or response dated 03/02/2011 10:35:38 AM CST to the provisos outlined in our correspondence of 25 Feb 2011 concerning the application for the above referenced project. The IRB determined that your application is eligible for **exempt** review under 45 CFR 46.101(b)(2) in that the study/project involves eligible research using educational tests, surveys, interview procedures, or observation of public behavior. In accord with 45 CFR 46.116(d), informed consent may be altered, with a consent cover statement used in lieu of an informed consent interview. The requirement to secure a signed consent form is waived under 45 CFR 46.117(c)(2). Willingness of the subject to participate will constitute adequate documentation of consent. Your application has been determined to comply with proper consideration for the rights and welfare of human subjects and the regulatory requirements for the protection of human subjects. Therefore, this letter constitutes full approval of your application, consent cover statement and survey, stamped approved by the IRB on 8 Mar 2011, for the above referenced study.

This study may not be initiated until you receive approval from the institution(s) where the research is being conducted.

In the event that volunteers are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB.

Any alterations (revisions) in the protocol, consent cover statement, or survey must be promptly submitted to and approved by the UTHSC Institutional Review Board prior to implementation of these revisions. You have individual responsibility for reporting to the Board in the event of unanticipated or serious adverse events and subject deaths.

Sincerely,

Appendix B

Signature applied by Holly A Herron on 03/08/2011 09:48:46 AM CST

Signature applied by Terrence F Ackerman on 03/08/2011 09:49:53 AM CST

Holly A Herron
IRB Administrator
UTHSC IRB

Terrence F Ackerman, PhD
Chairman
UTHSC IRB

Appendix C

THE UNIVERSITY OF MEMPHIS

Institutional Review Board

To: Marcia Sharp
Leadership

From: Chair, Institutional Review Board
For the Protection of Human Subjects
irb@memphis.edu

Subject: Critical Thinking Skills in Allied Health Students (031111-478)

Approval Date: March 26, 2011

This is to notify you that the Institutional Review Board has designated the above referenced protocol as exempt from the full federal regulations. This project was reviewed in accordance with all applicable statutes and regulations as well as ethical principles.

When the project is finished or terminated, please complete the attached Notice of Completion form and send it to the Board via e-mail at irb@memphis.edu.

Approval for this protocol does not expire. However, any change to the protocol must be reviewed and approved by the board prior to implementing the change.

Chair, Institutional Review Board
The University of Memphis

Cc: Dr. Katrina Meyer