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**AN ASSESSMENT OF POST-PROFESSIONAL ATHLETIC TRAINING
STUDENTS' CRITICAL THINKING SKILLS AND DISPOSITIONS**

by

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ABSTRACT

AN ASSESSMENT OF POST-PROFESSIONAL ATHLETIC TRAINING STUDENTS' CRITICAL THINKING SKILLS AND DISPOSITIONS

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The need for outcome measures in critical thinking skills and dispositions for post-professional athletic training programs (PPATPs) is significant. It has been suggested that athletic trainers who are competent and disposed towards thinking critically will be successful in the profession. The purpose of this study is to assess critical thinking skills and dispositions of PPATP students who entered a program in either the summer or fall of 2012 utilizing the California Critical Thinking Skills Test (CCTST) and the California Critical Thinking Disposition Inventory (CCTDI). All PPATP first year students entering the program during fall or summer of 2012 and one program during fall 2013 were solicited to participate in this study. Of the 182, potential participants 65 responded for a response rate of 35.7% (age = 22.55 ± 1.37), (BOC score = 578.20 ± 54.32), (GRE verbal reasoning = 151 ± 6.02), (GRE quantitative reasoning score = 149.91 ± 6.75), (GRE analytical writing score $3.92 \pm .57$), (undergraduate GPA = $3.56 \pm .28$). Data collection occurred over six months starting in the fall of 2012. Three email reminders were sent approximately one week apart via email. Students reported moderate total critical thinking skills (73.14 ± 9.87) and ambivalent truth-seeking (37.33 ± 5.12), positive open mindedness (42.05 ± 5.22), positive analyticity (44.43 ± 7.71), positive systematicity (41.43 ± 6.4), positive self-confidence (44.19 ± 5.92), positive

inquisitiveness (46.13 ± 5.7), and positive maturity of judgment (42.35 ± 4.97) on critical thinking dispositions. Cronbach's alpha coefficients for the CCTST was excellent (.96) and acceptable (.79) for CCTDI. No significant correlation was found between BOC score and CCTST total score ($r=.116, p=.412$). No significant correlation was found between CCTST total score and GRE verbal reasoning score ($r=.039, p=.836$), GRE quantitative score ($r=.203, p=.348$), or GRE analytical writing score ($r=-.070, p=.682$). No significant correlation was found between undergraduate GPA and CCTDI total score ($r=.056, p=.663$), nor between CCTST total score and CCTDI total score ($r=.221, p=.082$). Stepwise regression indicated age was a significant predictor of CCTST total score ($R^2=.396, F=13.755, df=1,21, p=.001$) and involvement of clinical instructor in education and length of program were significant predictors of CCTDI total score ($R^2=.362, F=5.958, df=2,21, p=.009$). Results indicate there is room for improvement in both critical thinking skills and dispositions of PPATP.

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CHAPTER I

INTRODUCTION

The increasing price of higher education and influx of student enrollment in colleges and universities has caused the public to examine how well these institutions of higher learning are preparing students for the future (Liu, 2011). There has been a major shift in higher education from a focus on curricular content to curricular outcomes (Rane-Szostak, 1996). In 2005, the Department of Education created the Commission on the Future of Higher Education with the purpose to preserve the leadership of higher education (Liu, 2011). One area that the Commission determined needed reform was the accountability of colleges and universities which they believed could be improved through providing evidence of learning (Liu, 2011).

At the same time, the American Association of State Colleges and Universities and the Association of Public and Land-Grant Universities developed the Voluntary System of Accountability ("Voluntary System of Accountability," 2008). The purpose of the Voluntary System of Accountability was to evaluate core educational outcomes and to enhance the public's knowledge of the functions of public colleges and universities ("Voluntary System of Accountability," 2008). The Voluntary System of Accountability included the College Portrait of Undergraduate Education which was a web-based program that permitted institutions of higher learning to provide standardized information about their students and learning outcomes. The core learning outcomes identified by the College Portrait of Undergraduate Education were written communication and critical thinking ("Voluntary System of Accountability," 2008).

These two skills were selected, because they were believed to be important for citizens to survive and thrive in the global economy ("Voluntary System of Accountability," 2008).

There are numerous definitions of critical thinking in the literature, likely due to the complicated and intricate process involved in critical thinking (Rane-Szostak, 1996). Ennis (1985) described critical thinking as, "reflective and reasonable thinking that is focused on deciding what to believe or do" (Ennis, 1985, p. 45). Watson and Glaser (2008) developed a critical thinking assessment tool based on their conceptualization of critical thinking as a combination of attitudes, knowledge, and skills (Watson, 2008). Critical thinking was further defined by Facione and an expert consensus in 1990 as the purposeful, self-regulatory judgment which results in the interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which judgment is based (P. Facione, 1990). For the purposes of the California Critical Thinking Skills Test (CCTST), Facione has simplified the definition to, "critical thinking is purposeful reflective judgment focusing on what to believe or what to do" (P. Facione, N. Facione, & Winterhalter, 2011, p. 4). Critical thinking is considered very important in health and human services for professional decision making (Drennan, 2010; N. Facione, P. Facione, & Sanchez, 1994). Clinicians who make good professional decisions will positively affect patient care.

The importance of critical thinking in health and human services is evidenced by the emphasis of critical thinking in nursing, physical therapy, and post-professional athletic training accreditation standards (CAPTE, 2010; CATE, 2013; CCNE, 2009; Nursing, 1996). In master's level nursing education, every student must acquire good

critical thinking skills since it is believed that these skills are required for evaluation, assessment, planning, and intervention of illness (Nursing, 1996). Similarly, critical thinking is an emphasis in the Commission on Accreditation in Physical Therapy Education's *Accreditation Handbook* (CAPTE, 2010). Physical therapy students are required to have learning opportunities both within and outside the field of physical therapy. It is believed that students will then be exposed to different ways of thinking, ethical behavior, values, and various social concepts which will help them identify, redefine, and fulfill their responsibilities to their profession and the rest of society (CAPTE, 2010). The *Accreditation Handbook* identifies emphasis in critical thinking, ethical practice, and provisions of culturally competent service to be of major importance (CAPTE, 2010). *Standards for the Accreditation of Post-Professional Athletic Training Degree Programs (Standards)* also emphasizes the need for athletic training post-professional students to acquire critical thinking skills (CAATE, 2013). In the "Program Delivery" section it is stated that, the program must include scholarly experiences designed to improve student critical thinking and decision making (CAATE, 2013).

Despite the emphasis on critical thinking skills in *Standards*, there is no standardized assessment of critical thinking skills or critical thinking dispositions of students enrolled in these programs. Previous studies in post-professional athletic training have questioned students about their educational programs' ability to improve critical thinking (Henry, 2009; Neibert, 2009). However, these studies relied on the students' own understanding of critical thinking. Overall, graduates of PPATPs reported that their programs improved their critical thinking (Henry, 2009; Neibert, 2009). Henry (2009) found that of all the areas outlined in the *Standards and Guidelines*, the graduates

were most satisfied with their program's ability to increase critical thinking (Henry, 2009). Neibert (2009), examined students of PPATPs and they identified *theoretic understanding* outlined in the *Standards and Guidelines* as an essential element in post-professional education, and that this understanding was advanced through critical thinking (Neibert, 2009). Students felt that their critical thinking skills were developed in the didactic component of their programs and solidified through the clinical component. The students also identified research as another area that increased critical thinking, because the researcher had to question common practice and critically think about clinical decisions (Neibert, 2009).

Other professions have assessed critical thinking skills in their graduate programs using standardized tests (Drennan, 2010; McMullen, 2009; Scott, Markert, & Dunn, 1998; Seldomridge, 2006; Vendrely, 2005; Wilson, 2000; Zettergren, 2004). In graduate nursing, two studies have examined critical thinking utilizing the CCTST to assess changes in critical thinking over the course of a two year nursing program, and to examine changes in critical thinking within the context of the clinical preceptor and student relationship (McMullen, 2009; Sorensen, 2008). Compared to the national norms in the subscales of evaluation, inference, and analysis those nursing students who had median or high scores upon program entry had a moderate increase in evaluation skills while their inferential scores remained the same (McMullen, 2009). Surprisingly, these students' analytical skills decreased upon completion of the program. On the other hand, nursing students who entered the program with lower scores on the three critical thinking subscales, experience an increase in all three subscale scores at the end of the program. It appears that this particular nursing program was able to increase the critical thinking

scores of those students who had lower critical thinking abilities at program entry.

However, the program was not able to significantly increase critical thinking scores of students who entered the program with high critical thinking abilities. Currently, there are no known published studies comparing PPATP students' critical thinking scores to national norms or to nursing master's level students. Research in Post-Professional athletic training students' critical thinking abilities is needed to compare scores with other health care professions.

The CCTST was used to assess changes in critical thinking skills of master's level nursing students whose clinical preceptors had taken a three hour course on encouraging critical thinking in students (Sorensen, 2008). Only the evaluation subscale score significantly increased after the education of the preceptors, indicating that education of the preceptors about critical thinking may not translate to significantly improved overall critical thinking scores in their students. Many PPATPs have preceptors similar to nursing. It is not known how the preceptor and student interaction affects critical thinking skills in athletic training. A baseline critical thinking score is needed in Post-Professional athletic training so that future research may be conducted on how to further improve critical thinking in PPATP students.

In medical school education only one study examining critical thinking skills was found, and that particular study utilized the Watson-Glaser Critical Thinking Appraisal (WGCTA) (Scott et al., 1998). Medical students were assessed upon entering the program and at the end of year three. A significant increase was noted between years one and three on total critical thinking scores, and critical thinking scores were positively correlated with the medical licensing exam indicating that those students who scored high

on critical thinking also scored high on the licensing exam. An assessment of students' critical thinking skills at the Post-Professional level is needed so that it can be compared with scores on the Board of Certification exam. It would be helpful for PPATP program directors to know if potential candidates' Board of Certification scores reflect their abilities to think critically.

In physical therapy the CCTST has been the preferred instrument for the evaluation of critical thinking skills (Vendrely, 2005; Wilson, 2000; Zettergren, 2004). In addition to the CCTST, one study in physical therapy also used the California Critical Thinking Dispositions Inventory (CCTDI) to assess student's disposition towards critical thinking and the WGCTA for critical thinking skills in order to establish concurrent validity of the CCTST and CCTDI (Wilson, 2000). In two of these studies, no significant differences in critical thinking disposition or skills were found after two semesters, or after twenty-seven months (Vendrely, 2005; Wilson, 2000). However, these studies were conducted on a single physical therapy program so the results cannot be generalized to other programs. The authors suggest that one possible reason for the insignificant change in the scores is due to a "ceiling effect" (Vendrely, 2005; Wilson, 2000). The "ceiling effect" occurs when students' scores on the initial test were high enough that significant improvements in scores could not be achieved. Another reason for the lack of significant change could simply be due to the program having little to no influence on students' critical thinking (Vendrely, 2005).

Contrary to the previous studies in physical therapy, significant differences in critical thinking were found during one five-year professional physical therapy program (Zettergren, 2004). Critical thinking skills were assessed in the third, fourth, and fifth

years of the program. Significant increases in critical thinking skills were found between the third and fifth year students as well as fourth and fifth year students (Zettergren, 2004). The authors believe that this study provides evidence that physical therapy education improves critical thinking and has implications for physical therapy education. However, the study was cross-sectional and there may have already differences between the groups of students. Also, the students were only tested at one point in time. Performing a baseline measure on first year PPATP students would not only provide valuable outcome measures for this cohort but would also be the first step in conducting a longitudinal study to better evaluate the effect of PPATPs on students' critical thinking skills and dispositions.

Statement of the Problem

The need for outcome measures especially in critical thinking skills and critical thinking dispositions for PPATPs is needed. It has been suggested that athletic trainers who are competent professionally and disposed towards thinking critically will be successful in the profession (Leaver-Dunn, 2002).

Purpose Statement

Therefore, the purpose of this study is to assess critical thinking skills and critical thinking dispositions of PPATP students who entered a PPATP program in either the summer or fall of 2012 utilizing the California Critical Thinking Skills Test and the California Critical Thinking Disposition Inventory.

Null Hypotheses

1. There will be no statistically significant relationship between Board of Certification scores and overall CCTST score.

2. There will be no statistically significant relationship between Graduate Record Exam scores and overall CCTST score.
3. There will be no statistically significant relationship between cumulative undergraduate grade point average (GPA) and total CCTDI score.
4. There will be no statistically significant relationship between the CCTDI overall score and the CCTST overall score.
5. There will be no statistically significant predictors of CCTST overall score.

Research Hypotheses

1. There will be a statistically significant positive relationship between Board of Certification scores and overall CCTST score (Bauwens, 1987; M. Gross, 1989; Y. Gross, Takazawa, E., & Rose, C., 1987; Scott et al., 1998).
2. There will be a statistically significant positive relationship between Graduate Record Exam scores and overall CCTST score (P. Facione, N. Facione, Blohm, S. W., Howard, K., & Giancarlo, C. A., 1998).
3. There will be a statistically significant positive relationship between cumulative undergraduate GPA and total CCTDI score (Wan, 2000).
4. There will be a statistically significant positive relationship between the CCTDI overall score and the CCTST overall score (P. Facione et al., 1998).
5. Cumulative GPA and all GRE subscale score will be significant predictors of CCTST total scores (P. Facione et al., 1998)

Independent Variables

1. Age
2. Board of Certification score

3. Graduate Record Exam scores
4. Cumulative undergraduate GPA

Dependent Variables

1. CCTST total scores and subscale scores
 - a. Analysis subscale score
 - b. Interpretation subscale score
 - c. Inference subscale score
 - d. Evaluation subscale score
 - e. Explanation subscale score
 - f. Inductive reasoning subscale score
 - g. Deductive reasoning subscale score
2. CCTDI total scores and subscale scores
 - a. Truth-seeking subscale score
 - b. Open-mindedness subscale score
 - c. Analyticity subscale score
 - d. Systematicity subscale score
 - e. Critical thinking self-confidence subscale score
 - f. Inquisitiveness subscale score
 - g. Maturity of judgment subscale score

Operational Definitions

1. Critical thinking is purposeful reflective judgment focusing on what to believe or what to do (P. Facione et al, 2011).

2. Analysis skill is to closely examine ideas, to identify assumptions, reasons and claims, and to gather detailed information from charts, graphs, diagrams, and paragraphs (P. A. Facione, Facione, N. C., & Winterhalter, K., 2011).
3. Interpretation skill is to determine the precise meaning of a sentence, passage, text, idea, assertion, sign, graph, diagram, signal, or chart in a given context and for a given purpose (P. Facione et al., 2011).
4. Inference skill is to draw conclusions based on reasons and evidence (P. Facione et al., 2011).
5. Evaluation skill is to assess the credibility of claims and the strength or weakness of arguments (P. Facione et al., 2011).
6. Explanation skill is to provide one's reasons, methods, assumptions or rationale for one's beliefs and conclusions (P. Facione et al., 2011).
7. Deductive reasoning moves from the assumed truth of a set of beliefs or premises to a conclusion which follows of necessity (P. Facione et al., 2011).
8. Inductive reasoning is drawing warranted probabilistic inferences regarding what is most likely true or most likely not true, given the information and the context at hand (P. Facione et al., 2011)
9. Truth-Seeking subscale measures the habit of always desiring the best possible understanding of any given situation; it is following reasons and evidence wherever they may lead, even if they lead one to question cherished beliefs (P. Facione & N. Facione, 2010)
10. Open-mindedness subscale measures the tendency to allow others to voice views with which one may not agree (P. Facione & N. Facione, 2010).

11. Analyticity subscale measures the tendency to be alert to what happens next.
12. Systematicity subscale measures the tendency or habit of striving to approach problems in a disciplined, orderly, and systematic way (P. Facione & N. Facione, 2010).
13. Critical Thinking Self-Confidence subscale measures the tendency to trust the use of reason and reflective thinking to solve problems (P. Facione & N. Facione, 2010)
14. Inquisitiveness subscale measures intellectual curiosity. It is the tendency to want to know things, even if they are not immediately or obviously useful at the moment (P. Facione & N. Facione, 2010).
15. Maturity of Judgment subscale measures the tendency to see problems as complex, rather than black and white. It is the habit of making judgment in a timely way, not prematurely, and not with undue delay (P. Facione & N. Facione, 2010).
16. NATA accredited post-professional athletic training program are post-professional graduate degree programs with the mission to expand the depth and breadth of the applied, experiential, and propositional knowledge and skills of entry level athletic trainers, expand the athletic training body of knowledge, and to disseminate new knowledge in the discipline (CAATE, 2013).

Assumptions

1. All students will answer the questions to the best of their ability.
2. All students will understand the questions and possible answers.

Limitations

1. The type of environment the student takes the test in cannot be controlled.
2. Outcomes will be affected by factors other than the PPATP.
3. The lack of a control group of other athletic training graduate students does not allow for examination of the effect of PPATPs on critical thinking skills and dispositions.
4. The instruments are self-reported.
5. There is a non-response bias due to the low sample size.

Delimitations

1. PPATP first year students entering the program during the fall or summer of 2012 and first year students from one institution entering the program during the fall of 2013 as identified by the institutions' program director.
2. The CCTST was chosen to measure critical thinking skills and the CCTDI were chosen to measure critical thinking dispositions.

CHAPTER II

REVIEW OF THE LITERATURE

This review of literature will begin by defining critical thinking skills and critical thinking dispositions as well as discuss common assessment tools used to measure these two dimensions of critical thinking. An overview of the critical thinking literature in healthcare related educational fields such as athletic training, nursing, medicine, and physical therapy will be presented.

Critical Thinking Skills

There are many definitions of critical thinking in the literature (Daly, 1998; Ennis, 1985; Rane-Szostak, 1996). John Dewey has been credited with introducing the more modern concept of critical thinking (Daly, 1998; Dewey, 1916). He claims that thinking involves four steps which are sensing a problem, observing conditions, formalizing and rationalizing a conclusion, and active experimental testing (Dewey, 1916). Critical thinking has been described by Ennis (1985) as a complicated and intricate process, (Rane-Szostak, 1996) and conceptualized by Watson and Glaser (2008) as a combination of attitudes, knowledge, and skills (Watson, 2008). Watson and Glaser also believe that critical thinking includes the ability to recognize a problem and realize the need for evidence to support what is believed to be true, knowledge of the character of valid inferences, abstractions, and generalizations in which the accuracy of various kinds of evidence are determined, and finally the skills in applying the previous attitudes and knowledge (Watson, 2008). Critical thinking is distinguished from some other forms of thinking as purposeful, unlike daydreaming or other automatic thinking which revolves around typical every day activities (Daly, 1998). It is furthermore an application of both

knowledge and experience in making judgments (Jones, 1993). In 1990, there was a consensus statement published which defined 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”(P. Facione, 1990). For the purposes of measuring critical thinking using the CCTST the consensus statement definition was simplified to “critical thinking is purposeful reflective judgment focusing on what to believe or what to do”(P. Facione et al., 2011). There is also the understanding that critical thinking does not only consist of skills but of dispositions as well (Daly, 1998; Ennis, 1985; P. Facione, 1990; P. Facione et al., 2011; Paul, 1984; Siegel, 1991). These dispositions will be discussed later in review of literature.

Six cognitive skills have been identified in the consensus statement as integral parts of the critical thinking process (P. Facione, 1990). These skills include interpretation, analysis, evaluation, inference, explanation, and self-regulation and each is further defined with various sub skills. In the CCTST, scores are obtained for each of these cognitive skills with the exception of self-regulation and the addition of inductive and deductive reasoning (P. Facione et al., 2011). Ennis (1985) describes creative activities that he feels are inherent in his definition of critical thinking (Ennis, 1985). These skills are formulating hypotheses, questions, and alternatives. Ennis has also identified twelve aspects of critical thinking which are grasping the meaning of a statement, judging for ambiguity in a line or reasoning, judging to see if certain statements contradict one another, judging whether a conclusion follows necessarily, determining if a statement is specific enough, judging whether a statement is the

application of a principle, judging whether an observation statement is reliable, judging whether inductive conclusion is justified, judging whether the problem has been identified, judging whether something is an assumption, judging whether a definition is sufficient, and judging whether a statement made by an authority is acceptable (Ennis, 1962). It is important to understand that not every person who is a good critical thinker is expected to be exceptional at all of these skills, but that these skills are important in critical thinking (P. Facione, 1990). In order to have a clear understanding of what it means to be a good critical thinker many of these skills and sub-skills needs to be defined.

The first cognitive skill of interpretation is the ability to understand the meaning or importance of various beliefs or experiences, judgments, and rules (P. Facione, 1990). Interpretation involves the ability to derive meaning from text, ideas, signs, graphs, charts or signals to name a few (P. Facione et al., 2011). Within the skill of interpretation there are three sub-skills which are categorization, decoding significance, and clarifying meaning (P. Facione, 1990; P. Facione et al., 2011). A good critical thinker should be able to take the experiences and beliefs and assign them to categories in order to comprehend their meaning. Decoding significance means that the person is able to view a symbol, chart, or listen to what someone is saying and ascertain its intent or relationship. Clarifying meaning is that the critical thinker can make things clear through the use of analogies, descriptions, or expressions.

Analysis is a person's ability to examine concepts, questions, or statements expressing a certain belief, reasoning, or opinion and determine the intended as well as actual inferential relationships among them (P. Facione, 1990). It is important that the

critical thinker be able to identify assumptions and gather details with precision (P. Facione et al., 2011). A poor analysis can lead to poor inferences and evaluations. Within the analysis skill is the sub-skill set of examining ideas, identifying arguments, and analyzing arguments (P. Facione, 1990). The sub-skill of examining ideas entails defining terms and contrasting ideas and concepts related to an argument. For example, a person should not only be able to state the problems and identify the components but relate those components to each other and the whole. The ability of a person to examine a statement, question, or some graphic representation and decide if these expressions present reasons to support or refute a claim or an opinion is the sub-skill of detecting arguments (P. Facione, 1990). After a person detects an argument he or she must then analyze the argument which, entails determining the main conclusion along with the reasons used to support the main conclusion.

The third critical thinking skill is evaluation, defined as the ability to assess the credibility of a statement related to opinions and beliefs (P. Facione, 1990). A critical thinker should also be able to determine the logic of the relationships among questions and statements. There are two subscales associated with evaluation: assessing claims and assessing arguments (P. Facione, 1990). Assessing claims is described as a person's ability to assess the credibility of a source of information as well as its contextual relevance. The person should also be able to assess how likely an opinion, belief, or situation is true. In a similar fashion, a critical thinker must find strengths and weaknesses of an argument and determine whether the justification for the truthfulness of that argument is acceptable (P. Facione, 1990; P. Facione et al., 2011). Additionally, a critical thinker should be able to differentiate between reasonable and false inferences

and be able to determine how much additional information is needed to support or refute an argument (P. Facione, 1990). Arriving at a correct conclusion does not necessarily mean that the person is a good critical thinker. A good critical thinker does not arrive at a correct conclusion based on a mistaken opinion or weak argument (P. Facione et al., 2011).

Inference is another important component of critical thinking that involves picking out the elements necessary to draw conclusions and create hypotheses based on evidence (P. Facione, 1990; P. Facione et al., 2011). Inferences may be drawn from various things including: information, data, facts, conjectures, behaviors, or documents (P. Facione et al., 2011). Within the skill of inference are querying evidence, conjecturing alternatives, and drawing conclusions (P. Facione, 1990). Querying evidence refers to understanding which arguments require support and how to seek information to provide that support (P. Facione, 1990). Conjecturing alternatives involves developing several plans to reach a goal or developing alternative hypotheses to an event. It also means that a person is able to identify presuppositions and can contemplate the various consequences of beliefs and decisions. The last component of inference is drawing conclusions. Drawing conclusions is using modes of inference in deciding which point of view to take on a particular matter and decide which conclusions are supported by evidence or should not be accepted given the information available. Unfortunately, inference does not ensure a correct conclusion since conclusions may be inferred from mistakes, incorrect data, biased information, and unreliable opinions (P. Facione et al., 2011). It is also the ability to examine a set of descriptions or statements and determine their inferential relationship as well as the possible consequences (P.

Facione, 1990). Another means of drawing conclusions can be to think in another mode such as scientifically, arithmetically, analogically, or dialectically.

Explanation is the ability to explain and justify one's reasoning taking into consideration the conceptual, evidential, methodical, and contextual considerations (P. Facione, 1990). Explanation includes stating results, justifying procedures, and presenting arguments. Stating the results means that a person can generate accurate descriptions or statements of the results of another's reasoning in order to evaluate those results. Justifying procedures is justifying one's own inferences by providing evidence used in forming that inference, while presenting arguments is being able to defend why a particular claim is accepted and be able to respond to possible criticisms.

Self-regulation is the ability to assess one's own cognitive activities (P. Facione, 1990). The sub skills include self-examination and self-correction. Self-examination is assessing one's own reasoning and application of cognitive skills that was used in the process. Also, assessing one's own opinions and reasons for believing them as well as acknowledging the various influences on developing those opinions is part of self-examination. The final component of self-examination is examining one's own motives and attitudes and determines whether they are unbiased and fair. The other sub-skill of self-correction involves developing a plan for correction of any mistakes discovered during the self-examination process.

The last two critical thinking skills of deductive reasoning and inductive reasoning are sub skills measured on the CCTST (P. Facione et al., 2011). In deductive reasoning, conclusions are drawn based on assumed truths. Computer programs,

geometry, and algebra are forms of deductive reasoning. As long as the premises are true the resulting conclusions cannot be false (P. Facione et al., 2011).

On the other hand, inductive reasoning draws inferences based on what is likely or unlikely to be true using the available information (P. Facione et al., 2011). Inductive reasoning occurs when there is the possibility of a mistake even if it is extremely small. An example of this would be disproving hypotheses in scientific research.

Affective Dispositions of Critical Thinking

The ideal critical thinker has several characteristics (P. Facione et al., 2011). The ideal critical thinker is described as habitually inquisitive with an array of issues and has a desire to be well informed (P. Facione, 1990; P. Facione et al., 2011). A critical thinker is also self-confident in his or her ability to reason (P. Facione et al., 2011). Open-mindedness, flexibility, and understanding regarding other people's views or opinions are also identified as important characteristics (P. Facione, 1990; P. Facione et al., 2011). This person must also be honest regarding his or her own biases, prejudices, or stereotypes and fair in evaluating all reasoning (P. Facione, 1990; P. Facione et al., 2011). Finally, the good critical thinker must be prudent in making decision and willing to change or revise views where reflection indicates the need for change (P. Facione, 1990; P. Facione et al., 2011).

Critical thinking dispositions are the attitudes, beliefs, and opinions a person possesses towards critical thinking (P. Facione et al., 2000). Most experts believe that affective dispositions towards critical thinking are just as important as the cognitive critical thinking skills in the critical thinking paradigm (Ennis, 1985; P. Facione, 1990; Paul, 1984). These dispositions are needed before the skills can flourish in the student (P.

Facione, 1990). Paul (1984) believed that critical thinking skills are integrated macrological skills that are intrinsic to the person's character and to insight into the person's cognitive and affective processes. Ennis (1985) believes the list of dispositions simply include being open-minded, paying attention to the total situation, seeking reasons, and attempting to be well informed (Ennis, 1985). The consensus statement on critical thinking includes a more comprehensive list in which good critical thinkers possess the following affective dispositions in their approach to life in general: inquisitiveness, desire to be generally well-informed, vigilant in opportunities to use critical thinking, confidence in the process of reasoned inquiry, self-assurance in one's ability to think, open-mindedness to different world views and opinions of others, understanding of other opinions, fair in assessing reasoning, recognition of biases, ability to make and change judgments, and inclination to change views when reflection of those views indicates that change is needed (P. Facione, 1990).

A good critical thinker also utilizes the following approaches in regards to questions, problems, or specific issues: clearly stating the question, organization in working with complex issues, dedication in finding relevant information, sound judgment in applying criteria, focus on the task at hand, perseverance through difficulty, and meticulousness to the point allowed by the situation (P. Facione, 1990).

All of the characteristics and dispositions defined in the consensus statement have been categorized into six dispositions or habits of the mind for measurement on the CCTDI (P. Facione & N. Facione, 2010). These six dispositions are truth-seeking, open-mindedness, analyticity or foresightfulness, systematicity, inquisitiveness, and

judiciousness or maturity of judgment (P. Facione & N. Facione, 2010). In order to understand these dispositions, each will need to be defined.

A person who possesses a truth-seeking disposition is one who desires to have the best understanding of a situation and will follow the evidence even if it causes the person to question his or her beliefs (P. Facione & N. Facione, 2010). A truth-seeking person pays attention to the details and strives to keep personal biases and preconceived ideas from overshadowing the truth. A person lacking in truth-seeking will often ignore or overlook evidence that would challenge his or her beliefs (P. Facione & N. Facione, 2010).

The next disposition of open-mindedness is allowing others to express views that may differ from one's own and be tolerant of those views (P. Facione & N. Facione, 2010). Open-mindedness is understanding that we hold beliefs that makes sense from our point of view and that this disposition is so important in society where people often approach issues based on religious, political, cultural, or personal background (P. Facione & N. Facione, 2010). A person that is lacking in open-mindedness is intolerant of others views and opinions (P. Facione & N. Facione, 2010).

Analyticity is the ability to anticipate what will happen next (P. Facione & N. Facione, 2010). A person with this disposition knows the potential good and bad consequences of decisions, situations, plans, and proposals while the person who does not analyze situations does not think about the consequences involved. The person lacking the disposition to analyze will also accept opinions and ideas without appraising them (P. Facione & N. Facione, 2010)

The third disposition is systematicity in which a person approaches problems in a disciplined and systematic manner (P. Facione & N. Facione, 2010). This person has a desire mentally to approach questions and problems in a systematic way. However, he or she may not know or be aware of a specific method to problem solving (P. Facione & N. Facione, 2010).

A person with critical thinking self-confidences trusts and uses critical thinking as an approach to problem solving (P. Facione & N. Facione, 2010). Critical thinking self-confidences can be possessed by individuals or a group such as a community or society. A community can be trustful of reasoned judgment as an approach to problem solving (P. Facione & N. Facione, 2010). Whereas an individual or group can devalue or even be hostile towards the idea of reasoned judgment.

The fifth disposition is inquisitiveness which is characterized as intellectual curiosity and the desire to know things even if they are not useful at the time (P. Facione & N. Facione, 2010). An inquisitive person has the desire to obtain new knowledge and explanation of things. The opposite of an inquisitive person is an indifferent person (P. Facione & N. Facione, 2010).

The last disposition is judiciousness (P. Facione & N. Facione, 2010). Judicious persons will see the complexity of issues rather than seeing them as black and white. They make judgments in a timely manner and not prematurely or with long delay. They know when to stand firm in their judgments and when to make changes. Judicious persons recognize that multiple solutions may exist to a problem, and that sometimes decisions need to be made even though there is not complete knowledge on the matter (P. Facione & N. Facione, 2010). On the other hand, a person who is cognitively immature

will see issues as black and white and fails to make decisions in a reasonable amount of time (P. Facione & N. Facione, 2010). There is also refusal to change one's mind even when evidence indicates the necessity to do so or the person changes his or her mind without sufficient reasoning.

Measuring Critical Thinking Skills and Dispositions

There are numerous commercial instruments available for assessing critical thinking. There are advantages and disadvantages to using each. In the following section, the most popular assessment tools for critical thinking will be discussed.

California Critical Thinking Skills Test. The CCTST is a range of 33 to 35 multiple choice exam questions that focuses on seven sub-scales of critical thinking skills which are analysis, interpretation, inference, evaluation, explanation, deductive reasoning, and inductive reasoning (P. Facione et al., 2011). The test was originally created from the *APA Delphi Report* for college aged students but has been used in high school students grades ten through twelve and for graduate students (P. Facione et al., 2011). The CCTST has been utilized across the world and has been translated into a total of seventeen languages (P. Facione et al., 2011). In the writing of the test there is no technical language used and the subject matter of the test is not discipline specific but is based on knowledge that is obtained through elementary school, secondary school, and maturation (P. Facione et al., 2011; P. Facione et l., 1998). Items on the CCTST are written in various degrees of difficulty and should take participants approximately forty-five minutes to complete the CCTST (P. Facione et al., 2011; P. Facione et l., 1998). Currently, the test can be administer both on-line or pencil and paper format (P. Facione et al., 2011).

In scoring the CCTST, eight separate scores may be obtained on a one hundred point scale (P. Facione et al., 2011). The eight scores are one overall critical thinking score and seven subscale scores including: analysis, interpretation, inference, evaluation, explanation, inductive reasoning and deductive reasoning. Each of the subscale definitions are based on the *APA Delphi Report* (P. Facione et al., 2011). Cut-off scores range from greater than 85 (high) and less than 70 (low) for total score and greater than 84 (high) and less than 70 (low) for each subscale (P. Facione et al., 2011). The total score is the best indicator of critical thinking skills (P. Facione et al., 2011). The subscale score can assist programs in determining what areas of critical thinking the program should focus on. However, these sub-scales are not a set of discrete skills that define critical thinking (P. Facione et al., 2011).

The CCTST has been shown to be both valid and reliable (P. Facione et al., 1998). Kuder Richardson – 20 internal consistency estimates ranged from .68 to .70 for both test A and test B in the original creation of the CCTST. Additionally, reliability estimates based on correlations between test A and test B for one sample of students yielded .78. Content validity was established by choosing items based on a theoretical relationship to the Delphi study on critical thinking. Both sex-role and social class stereotypes were avoided and equal number of females and males are referenced in order to reduce cultural and gender bias.

Construct validity has been assessed for the CCTST in a couple of ways. One group of college students responded orally to the CCTST and gave justifications for their answers in order for the researcher to determine if the answer choice was selected by application of the appropriate cognitive skill (P. Facione et al., 1998). Another means to

assess construct validity was to assess students improvement in CCTST scores after taking a course in critical thinking skills compared to those who had not taken a course (P. Facione et al., 1998). Students experienced a significant increase in CCTST scores after taking the critical thinking class.

Criterion validity is established through positive correlation with school success (P. Facione et al., 1998). The CCTST score have been positively correlated with the Graduate Record Exam (GRE) total score as well as the GRE analytic score, GRE verbal, and GRE quantitative. It is also been positively correlated with the ACT, CCTDI total score, SAT verbal, SAT math, college grade point average, Nelson-Denny, and Watson-Glaser CTA (P. Facione et al., 1998). There have been no significant differences between males and females or among various races (P. Facione et al., 1998).

As mentioned previously the CCTST has been shown to be correlated with the GRE. The GRE board was established in 1966 and affiliated with the Association of Graduate Schools and the Council of Graduate Schools (Service, 2012). The GRE is administered by the Educational Testing Service and the general tests measures three skills: verbal reasoning, quantitative reasoning, critical thinking, and analytical writing skills (Service, 2012).

The verbal reasoning portion of the GRE general test measures the ability to draw conclusions from both incomplete data and discourse (Service, 2012). It is the understanding of literal, figurative meanings, summarizing text, and distinguishing from major and minor points. The passages are taken in equal parts from the subject matter of social science, humanities, and natural sciences.

The quantitative reasoning section assesses the ability to problem solve using mathematical models, comprehend quantitative information, and analyze quantitative information (Service, 2012). It covers basic arithmetic, algebra, geometry, and data analysis. In recent forms of the GRE general test there are new types of questions in this section and computer-enabled tasks.

The last section is analytic writing section measure the ability to appraise claims and supporting evidence and to provide proper reasons and examples to support ideas (Service, 2012). Test takers are required to complete two tasks in the analytic writing section. One is to analyze and issue and the other is to analyze an argument. Topics can vary within the two tasks from the fine arts, social science, or physical science. There is more than one way to answer these questions and no content knowledge is needed in order to respond. Administration of the GRE can be both computer and paper based.

Watson-Glaser Critical Thinking Appraisal. The Watson-Glaser Critical Thinking Appraisal (WGCTA) is another critical thinking assessment used in health care professions. This test is based on older conceptualizations of critical thinking than the CCTST and is comprised of five tests on inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments (Watson, 2008). There is both a form A and B of the test which allows for assessment of the effectiveness of critical thinking educational programs and a short form. The A and B forms take approximately one hour to administer while the short form requires thirty minutes (Watson, 2008). Items on the WGCTA are comprised of scenarios or passages that include either a problem, statement, argument, or interpretation of data that one might experience in a typical day (Watson, 2008). Each item is accompanied by numerous possible responses

which are either neutral or controversial in nature. The neutral responses tend not to evoke an emotional response such as weather or scientific fact while the controversial responses may involve political, economic, or social issues (Watson, 2008).

Evidence of reliability and validity of the WGCTA has been established (Watson, 2008). In a study of internal consistency reliability during the development of the WGCTA short form, the Cronbach's alpha coefficient was reported to be .81 (Watson, 2008). In a test-retest reliability study, 42 employees from a large publishing company completed the WGCTA short form twice with two weeks separating the testing (Watson, 2008). This reliability score was .81 ($p < .001$).

Criterion and convergent validity have also been established for the WGCTA short form (Watson, 2008). In 2005, Watson and Glaser conducted a study on 142 job incumbents from differing industries (Watson, 2008). The results indicated that the Watson-Glaser test scores were correlated .33 with supervisor rating of analysis and problem solving behaviors and .23 with supervisor rating on judgment and decision making behavior. Also, in this study a .33 correlation was found between WGCTA scores and job success indicated by organizational level achieved. With regards to convergent and discriminant validity the Watson-Glaser total scores correlated .70 with scores on the *Miller Analogies Test for Professional Selection* (Watson, 2008). The previously mentioned study had been conducted on 63 individuals employed in the industrial setting by Harcourt Assessment.

Although, the WGCTA has been shown to be both valid and reliable it only measures critical thinking skills and not critical thinking dispositions (Walsh, 2006). Additionally, it was not created with the college population. It has also been suggested

that since the Watson-Glaser is very definition dependent, it can only be used in assessing programs that have the same definition of critical thinking (Rane-Szostak, 1996).

The Ennis-Weir Critical Thinking Essay Test. The Ennis-Weir Critical Thinking Essay Test was originally developed to be a critical thinking test but may also be used as teaching material in a short course on critical thinking (Ennis, & Weir, 1985). This assessment of critical thinking focuses on the argumentation part where a person must respond to a complex argument with his or her own argument that responds to the first (Ennis, & Weir, 1985). Since the test is open-ended it must be subjectively scored. The general areas of critical thinking that The Ennis-Weir claims to cover are getting the point, seeing the reasons and assumptions, stating one's point, offering reasons, and seeing other possibilities (Ennis, & Weir, 1985). Participants are also expected to avoid or to respond appropriately to equivocation, irrelevance, circularity, reversal of a conditional relationship, the straw person fallacy, overgeneralization, excessive skepticism, credibility of problems, and use of emotion to persuade (Ennis, & Weir, 1985). This particular test does not measure deductive reasoning but similar to both the CCTST and WGCTA it does not use technical language.

The Ennis-Weir is set up as a letter to the editor of a fictional newspaper (Ennis, & Weir, 1985). The letter is a proposal from a writer with arguments to support the proposal. The letter comprises of eight paragraphs which contain errors in reasoning such as the ones listed previously. The test taker must evaluate and write an argument in response to each paragraph and to the letter in its entirety (Ennis, & Weir, 1985). The test should take participants about 40 minutes to complete (Ennis, & Weir, 1985).

In regards to validity of The Ennis-Weir, the test can only be said to have content validity (Ennis, & Weir, 1985). The participants demonstrate skills at appraising and formulating arguments. Also, the type of problems presented give opportunity to assess areas of critical thinking. Neither predictive nor concurrent validity have been assessed for this test. Inter-rater reliability was established by having two different graders score 27 essays written by college students and gifted eighth graders (Ennis, & Weir, 1985). Inter-rater reliabilities were .86 and .82.

Despite the data provided by the authors, reliability for The Ennis-Weir is still a concern since those scoring the test must have only had a minimum of one year of a college level in critical thinking, logic, or similar course (Rane-Szostak, 1996). This particular test may serve well as an education tool for critical thinking and not as a measure of critical thinking (Rane-Szostak, 1996).

Cornell Critical Thinking Test. The Cornell Critical Thinking Test (CCTT) is based on Ennis' concept of critical thinking and has two versions: Level X and Level Z (Lauder, 2001). Level X is considered the less difficult of the two and is geared towards high school students. Level Z on the other hand is made for gifted high school students, college students and older adults. Level X consists of 71 multiple choice items measuring critical thinking skills (Lauder, 2001). It is comprised of four subscales which are induction, deduction, observation and credibility, and assumptions. The Level Z split-half reliability range from .55 to .76 (Lauder, 2001).

California Critical Thinking Disposition Inventory. The California Critical Thinking Disposition Inventory (CCTDI) measures a person's disposition towards critical thinking including opinions, beliefs, and attitudes towards critical thinking (P. Facione et

al., 2000). The CCTDI includes seventy-five items measuring seven disposition scales following the definition of the consensus statement: truth seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and maturity (P. Facione, 1990; P. Facione et al., 2000). There are nine to twelve items under each subscale in which participants are to rate to what degree he or she agrees with each statement. Answers are recorded on a six point Likert scale of “strongly agree” to “strongly disagree” with no neutral response available. Positive disposition responses are awarded four to six points while negative responses are given one to three points. Each statement represents common opinions or perceptions and uses no critical thinking vocabulary or college level content knowledge. Unlike the CCTST the subscale scores reveal more information than the total disposition score (P. Facione et al., 2000). The CCTDI should take participants between 15 to 20 minutes to complete.

Factor analysis was used to determine which items should be retained in the final CCTDI (P. Facione et al., 2000). Means and ranges for factor loadings ranged from .387 to .528. Cronbach’s alpha and factor analytic statistical analyses of responses were used on the pilot of the CCTDI which supported several common factors in the disposition toward critical thinking. The internal consistency reliability ranged from .71 to .80. After the statistical analyses were conducted the nineteen descriptive phrases of critical thinking were reduced to seven dispositional characteristics to describe the ideal critical thinker in the present form of the CCTDI.

Validity and reliability have been well established for the CCTDI (P. Facione et al., 2000). Face validity has been established by college instructors indicating that the items on the CCTDI are applicable to the target dispositions. Also, the intent of the

CCTDI is not to assess critical thinking skills. It may be that some participants value the ideas of critical thinking but in the skills sense are unable to think critically.

The CCTDI has also been correlated to “openness to experience” and “ego-resiliency.” The scales of truth seeking, open-mindedness, critical thinking confidence, and inquisitiveness are all positively correlated with “openness to experience” (P. Facione et al., 2000). The correlation values for these four subscales ranged from .25 to .37. On the other hand, all of the subscales were positively correlated with “ego-resiliency” with the three highest being truth seeking, systematicity, and inquisitiveness. Additionally, the CCTDI has been shown to be positively correlated with ACT and SAT-Verbal scores (P. Facione et al., 2000).

Critical Thinking in Graduate Education

Nursing Graduate Education. Critical thinking is a part of the accreditation standards for both baccalaureate and master’s level nursing education (CCNE, 2009; Nursing, 1996). For the master’s level nursing programs, every graduate must acquire good critical thinking and decision making skills (Nursing, 1996). It is believed that these skills are necessary for evaluation, assessment, planning, and intervention of illness and consequently can improve patient outcomes. It is believed that this should be a focus of advanced nursing education and that master’s course work should increase student’s knowledge and skills in critical thinking and decision making (Nursing, 1996).

The nursing profession is in the forefront in regards to assessing master’s level students’ critical thinking skills (Drennan, 2010; McMullen, 2009; Sorensen, 2008). There is evidence to suggest that completing a nursing master’s degree contributes to improved critical thinking skills (Drennan, 2010). When comparing critical thinking

skills of incoming master's students compared to graduated master's students in all six institutions offering Master's in Nursing programs in Ireland, it has been reported that graduates had statistically significant higher scores on the Watson-Glaser Critical Thinking Appraisal (WGCTA) than those master's students entering the program (Drennan, 2010). The authors claim that the results indicate that the master's program had an impact on improving critical thinking skills (Drennan, 2010). However, this study was a cross sectional study and not a longitudinal study, meaning that the two cohorts compared in this study were two different groups of participants. The group entering the program was significantly younger and had less clinical experience than the graduated group. It may be that the improvement in critical thinking had nothing to do with the educational program but with individual's experience and maturity, especially since the graduate group included graduates between 2003 and 2007. There is the possibility that improvement in critical thinking may have occurred without the program as well. As suggested by the author clinical experience may have contributed to the increase in critical thinking ability (Drennan, 2010).

Another study examined the effects of a two year graduate nursing education program on the critical thinking sub-skills of evaluation, inference, and analysis using the California Critical Thinking Skills Test (McMullen, 2009). The objective was to identify how critical thinking skills changed rather than determining if they changed. It is interesting to note those students with high or median levels of critical thinking skills as compared to national norms experienced an increase in their evaluation skills while their inference skills remained stable and their analytical skills declined after the two years. On the other hand, those students with lower levels of critical thinking skills at the

commencement of the program experienced an increase in all three critical thinking skills. The authors indicate that the variety in growth patterns is to be expected since adults tend to demonstrate different levels of competence under various conditions of support (McMullen, 2009). The reason as to why analytic skills decreased for students entering the program with higher level of critical thinking skills is because the program provided adequate support for upper level skills of evaluation and inference but not enough support to maintain the upper level skills of analysis (McMullen, 2009). Out of the three skills assessed, analysis is the most difficult skills because students must identify the relationships among questions and statements (McMullen, 2009).

Aside from assessing the effects of an educational program on students' and graduates' critical thinking skills, one study evaluated the effects of an educational course for clinical preceptors on the critical thinking skills of nursing master's level students (Sorensen, 2008). The clinical preceptor and student relationship is highly valued in nursing education, and there is some evidence that teaching clinical preceptors how to facilitate critical thinking in their students can have a positive impact on the student's ability to think critically in the clinical setting (Sorensen, 2008). "Precepting in the Fast Lane" was a three hour continuing education program created to teach nursing preceptors how to encourage critical thinking in their graduate students (Sorensen, 2008). This educational program helped the preceptors to encourage their graduate students to think independently about problems or questions. They began asking their students higher level questions in order to promote their critical thinking and used different strategies in order to assist students with developing critical thinking skills. The preceptors reported that they felt as though they were empowering their student to think critically and noticed

a difference in the student's focus by the end of the relationship. Clinical preceptors even reported changing their own practice as a result of "Precepting in the Fast Lane." In regards to the student's critical thinking on the CCTST scores, the only subscale that was significantly different from the control groups was the evaluation subscale. However, the difference in this subscale score demonstrates that the preceptors' preparation did have a positive impact on new graduate nurses (Sorensen, 2008). The preceptors assisted students in connecting the theoretical and practice-based knowledge (Sorensen, 2008). It was the skills learned by the preceptors in the short course that facilitated a higher learning process (Sorensen, 2008). The authors suggest that assessing learning outcomes in students as a result of preceptor education is important (Sorensen, 2008).

Medical School Education. There is some evidence to indicate that three years of medical school education improves students critical thinking abilities. (Scott et al., 1998) One study examined the change in critical thinking skills over three years of medical school education as well as, assessed the relationship between critical thinking as measured by the WGCTA and clinical clerkship performance. (Scott et al., 1998) The WGCTA was administered to students upon entry to medical school and after three years in the program. There was a significant increase in total scores between the first and third year. However, there was no significant difference between men and women in total scores between the first and third year. On the subscale scores of the WGCTA there was only a significant difference for the evaluation of arguments subscale. Additionally, there was a significant positive correlation between years one and three on WGCTA scores. The authors believe that the scores in critical thinking improved over time due to progressive nature medical education process (Scott et al., 1998). Through-out the course

of the medical education, students build on their knowledge base as they move from preclinical year to their clinical years. In the clinical years students must validate inferences through appraising sources of information, and identify problems through questioning and reflecting. Some of the problems that the students identify have no clear correct answer which the students must learn to cope with. Lastly, the environment that medical students are in improves critical thinking. Students participate in an educational process where higher learning and integration and use of information occur. Also, the group of students was homogeneous due to the selectivity of admission and the attrition of weaker students at the beginning of the program (Scott et al. , 1998).

Other relationships were examined, and it was found that there was a significant relationship between the USMLE Step 2 score and total critical thinking score as well as all critical thinking subscale scores with the exception of evaluation of arguments at program entry (Scott et al., 1998). Near the end year three there was a significant relationship in USMLE Step 2 score and total score and each subscale with the exception of recognition of assumptions and deductions subscale. It is likely that there was correlation between the USMLE Step 2 and critical thinking because the USMLE Step 2 partly measures problem solving ability.

When examining clerkship tests there was a significant relationship between the clerkship tests in medicine, psychiatry, and surgery and total critical thinking score near the end of year three only (Scott et al., 1998). On the other hand, there was no significant relationship between the clerkship tests for obstetrics and gynecology or pediatrics and critical thinking at either program entry or end of year three. In regards to the National Board of Medical Examination (NBME), there was a significant relationship between the

subjects of medicine and obstetrics/gynecology and total critical thinking scores at both program entry and near the end of year three (Scott et al, 1998). However, there was a significant difference between NBME surgery score and critical thinking score near the end of year three. The authors felt there were at least three reasons why the correlations between total critical thinking scores and clerkship test and NBME were overall fairly low (Scott et al., 1998). The first reason is because the NBME and the clerkship evaluation do not measure the same factors as the WGCTA. Both the NBME and the clerkship evaluation measure knowledge of specific subjects. Secondly, the clerkship evaluations were not standardized measures, and previous internal reliability assessments found these evaluations to be unreliable. Finally, there is a lack of variability in scores on the clerkship evaluation, because students who scored poorly on the test were often dismissed before the end of year three (Scott et al., 1998).

When assessing clinical ratings, there was a significant relationship between the clinical ratings and total critical thinking for both entry and year three for medicine and on entry only for psychiatry (Scott et al., 1998). There was also a significant relationship between clinical ratings and total critical thinking at year three for pediatrics. The authors speculate that these relationships were weak because again clinical ratings measure different factors than the WGCTA (Scott et al., 1998). Clinical ratings measure interpersonal skills and relationships, dedication, enthusiasm, technical skills and reliability. Furthermore, clinical preceptors tend to rate most students above average revealing a leniency effect (Scott et al, 1998).

A relationship between final grade and critical thinking was also assessed. The results demonstrated that there was a significant relationship between these two variables

upon entry for medicine, obstetrics/gynecology, and psychiatry (Scott et al., 1998). A significant relationship was also found at year three for all disciplines except pediatrics. Specifically, scores were higher on the subscales of inference, interpretation, and evaluation of arguments. The correlation between academic success and these three subscales indicate that these skills may be more important in the educational process.

Finally, there was a significant relationship between the United States Medical (P. Facione et al, 1998) Examination (USMLE) and critical thinking total scores at both entry and year three (Scott et al., 1998). Additionally, there was a significant relationship between the USMLE and each subscale of the WGCTA with the exception of evaluation of arguments upon entry.

Others have examined the correlation of WGCTA scores with academic success within preclinical medical education (D. A. Miller, Sadler, J. Z., & Mohl, P. C., 1993; Scott & Markert, 1994). Participants were from Wright State University School of Medicine (Scott & Markert, 1994) and the University of Texas Southwestern Medical Center at Dallas Southwestern Medical School (D. A. Miller et al., 1993). The WGCTA was given to ninety-two students during orientation before classes began at Wright State University and to one hundred ninety-six student at University of Texas Southwestern Medical Center during the second half of their senior year (D. A. Miller et al., 1993; Scott & Markert, 1994). The results indicated that there was a negative relationship between age and time between undergraduate degree and entrance into medical school (Scott & Markert, 1994). The negative relationship between critical thinking and age could be due to the fact that older people take longer to answer question and process information (Scott & Markert, 1994). Also, it is suggested that once students leave undergrad and proceed

to a focus career that various areas of critical thinking are not utilized, leading to a decrease in skills (Scott & Markert, 1994). Conversely, a positive correlation was found between critical thinking scores and all MCAT subtest scores with the highest in reading (Scott & Markert, 1994). Scores on this subtest of the MCAT were higher due to the nature of the test. Students must be able to foresee consequences of a plan as well as evaluate and analyze information which are all skills within critical thinking (Scott & Markert, 1994). There was also a positive relationship between critical thinking scores and final scores for all first and second year courses with the exception of pharmacology class (Scott & Markert, 1994). The varying level of correlation between courses and critical thinking is most likely a reflection of how the course is taught, the exam structure, and how well the students prepare for exams (Scott & Markert, 1994). Finally, there was a positive relationship between critical thinking and GPAs at the end of the first and second year (Scott & Markert, 1994). This relationship may be due to the increased intensity of medical school courses, similarity of exam structure, and consistent grading criteria (Scott & Markert, 1994).

In the other study, sixteen of twenty-five course examinations, most of which had a clinical component, were correlated with the WGCTA composite score (D. A. Miller, Sadler, J. Z., & Mohl, P. C., 1993). There was at least one examination from genetics, cell biology, pathology, and endocrinology class that correlated with total WGCTA scores. The authors state that the results demonstrate that exams can be created that require critical thinking skills even in courses that require a lot of recall (D. A. Miller et al., 1993). High correlations were also found between the total WGCTA score and the MCAT and NBME pathology subject exam. The authors suggest that these findings may

be because these standardized exams rely on standard knowledge bases and skill attainment while other criterion referenced tests focus on idiosyncratic knowledge contact that is characteristic of local faculty (D. A. Miller et al., 1993).

Physical Therapy Education. Similar to nursing, critical thinking is a required component in the accreditation standards for physical therapy (CA PTE, 2010). There are three areas of interest in the Commission on Accreditation in Physical Therapy Education's *Accreditation Handbook* (CAPTE, 2010). These areas are critical thinking, ethical practice, and provision of culturally competent service.

Despite critical thinking being a required component of accreditation, there is little research in master's level physical therapy. In the existing research, there is conflicting results on the impact of physical therapy education on critical thinking (Wilson, 2000; Zettergren, 2004). The results of one particular study indicate that there is no significant change in CCTST or CCTDI over two semesters of physical therapy education (Wilson, 2000). A group of fifty-four physical therapy students entering the first year of a master's physical therapy program were assessed using both the CCTST and CCTDI and retested after the second semester. One possible reason for the insignificant results is the "ceiling effect" as the physical therapy students had high scores on the tests during the first assessment. Therefore, there was little room for improvement on the second test.

Another study found similar results when examining changes in critical thinking over a 27-month master's level physical therapy education program (Vendrely, 2005). Sixty-six subjects graduating between 1998 and 2001 were given the CCTST upon entering and completing the program. Although, there was an increase in the total

CCTST score for the students between the pre-test and post-test measures, it was not a statistically significant change. It was suggested by the authors that the lack of a significant finding may be due to the program simply not changing critical thinking skills. Another possible reason is the ceiling effect because the pre-test scores were so high. However, the limitations of the study were that the sample size was small and the study was only conducted on one physical therapy education program.

Conversely, different results were demonstrated when assessing 200 students enrolled in a five year professional Master of Physical Therapy program (Zettergren, 2004). Three groups of students in their third, fourth, and fifth year in the program were assessed using the CCTST. There was an increase in CCTST scores from the third through fifth year. However, there were only significant differences between the third and fifth year and fourth and fifth year. There were no significant differences between the third and fourth years. The fifth year students may have scored significantly higher than the other years because of participating in an eight week clinical internship in the summer prior to the fifth year (Zettergren, 2004). The clinical experience may have improved students' critical thinking skills as indicated by the authors.

Post-Professional Athletic Training. At the time of this literature review there were no published study examining critical thinking skills in PPATP students. *Standards for the Accreditation of Post-Professional Athletic Training Degree Programs (Standards)* emphasizes the need for athletic training post-professional students to acquire critical thinking skills (CAATE, 2013). In the "Program Delivery" section it is stated that, the program must include scholarly experiences designed to improve student

critical thinking and decision making (CAATE, 2013). The *Standards* inclusion of critical thinking indicates the need for outcomes measures of critical thinking in PPATPs.

Limited studies exist when examining the use of the CCTST in the assessment of critical thinking in graduate students in health professions (Table 1) (McMullen, 2009; Sorensen, 2008; Vendrely, 2005; Wilson, 2000; Zettergren, 2004). Only one of these studies utilized the CCTDI to assess students disposition towards critical thinking (Wilson, 2000). In this study, the CCTDI was administered to physical therapy students within two weeks of entering the program, three weeks after the initial measure for reliability purposes, and at the end of two semesters of physical therapy education. The means and standard deviations for the three assessments were 315.3 ± 19.5 , 314.0 ± 23.7 , and 304.0 ± 28.1 respectively

Critical Thinking Disposition in Baccalaureate Education

Athletic Training. Ninety-one students from three professional athletic training education programs from one regional and two comprehensive public institutions were assessed using the CCTDI at the beginning of the spring semester before the start of any athletic training classes (Leaver-Dunn, 2002). Overall, students demonstrated having a weak disposition towards critical thinking on the CCTDI. Out of all the CCTDI subscales, truth seeking was the lowest score in all three programs (35.10 ± 5.66). A significant difference was also found in truth seeking, maturity, and open mindedness subscales and the total score between the schools. However, after post hoc tests only the open-mindedness subscale differed with one of the comprehensive universities scoring higher than the regional. Additionally, no significant relationships between CCTDI

Table 1. Comparison of CCTST Total Scores in Health Care Professions at the Master's Level

Author	Profession	CCTST Total Score Mean±SD
Sorensen HA & Yankech, 2008	Nursing	Control: 17.69±3.93 Experimental: 18.27±5.50
McMullen MA & Mullen WF, 2009	Nursing	19.44±3.56
Wilson RW, 2000	Physical Therapy	Initial: 19.4±4.3 3 weeks: 20.3±4.6 2 semesters: 20.0±4.1
Zettergren KK & Beckett R, 2004	Physical Therapy	3 rd year: 18.41* 4 th year: 19.19* 5 th year: 21.00*
Vendrely A, 2005	Physical Therapy	Pre: 19.3171±4.34 Post: 20.6098±4.10
Facione PA, 1990	Nursing	19.01±0.41

* No standard deviation reported

scores and year in in the athletic training education program, cumulative GPA, completed semester hours, and clinical experience hours were found.

The authors believe that truth-seeking tends to be low because of the competency and fact driven educational process in athletic training (Leaver-Dunn, 2002). Often the students are tested on facts so the students are mainly concerned with obtaining the right answer and not questioning why it is the right answer. This type of educational atmosphere is not conducive to truth seeking and causes students to become passive learners. As for the differences between the comprehensive and regional universities the authors did not feel that their data allowed them to explain why the differences exist (Leaver-Dunn, 2002). They did hypothesize that these differences were not unique to these institutions or to athletic training and that differences may be due to the characteristics of the two types of universities and the kind of students that attend them. Students at larger universities interact with a more diverse population and are exposed to many different views. This type of exposure would attract students who would feel comfortable in that type of environment. Students attending larger universities might be expected to have higher open-mindedness scores. The lack of relationship between critical thinking disposition and year in the program and semester hours completed can be explained by the fact that critical thinking dispositions tend to be stable over time (Leaver-Dunn, 2002). The authors also speculated that there may not have been a significant correlation between clinical hours and critical thinking disposition because a large number of clinical hours does not mean they were quality hours (Leaver-Dunn, 2002).

Nursing. There is an abundance of information about CT disposition in the nursing literature. Studies utilizing the CCTDI have been conducted throughout the world including: the United States of America, (McCarthy, 1999),(Mei-Ling, 2003), (Colucciello, 1997, 1999; N. Facione, et al., 1994; Fero, 2010; Giddens, 2005; Sizemore, 2007; Stewart, 2005) Japan, (Kawashima, 2004) Canada, (Profetto-McGrath, 2003) (Carter, 2008) China, (Mei-Ling, 2003; Tiwari, Avery, & Lai, 2003; Tiwari, Lai, So, & Yuen, 2006; Wan, 2000; Wu, 2010) Australia, (Tiwari et al., 2003) Netherlands,(Paans, 2010) Turkey, (Ozturk, 2008) Korea, (An, 2008; Shin, 2006) Jordan, (W. Suliman, & J. Halabi, 2007) and Saudi Arabia (W. Suliman, 2006). Aside from simply examining CT dispositions, CT dispositions have also been compared to learning styles,(An, 2008; Colucciello, 1999; W. Suliman, 2006; Wu, 2010) performance on the NCLEX-RN, (Giddens, 2005) problem based learning,(Ozturk, 2008; Tiwari et al., 2006) diagnosis accuracy, (Paans, 2010) critical thinking skills, (Colucciello, 1997; Profetto-McGrath, 2003; Shin, 2006) self-esteem and state anxiety (Sizemore, 2007).

Many of the studies where CT Disposition is measured are cross sectional studies. In one such study, 122 Hong Kong nursing students finishing their first, second, and third years of a baccalaureate program were assessed (Wan, 2000). Overall, these Chinese nursing students showed a negative disposition toward critical thinking with the truth-seeking subscale score being the lowest of all the subscales. It is possible that the authoritarian educational system of China may not be conducive to critical thinking (Wan, 2000). It is also speculated that Hong Kong students have little confidence in their ability to solve problems on their own based on seeking, interpreting, and applying information they have found. The specific low score in truth seeking may be due to the

common attitudes of current freshman of being only concerned with the authoritarian correct answer (Wan, 2000).

Interestingly, the year three students scored lower than the other two groups on the overall score and on five of the subscales (Wan, 2000). Low scores in the third year may be attributed to the third year curriculum actually making critical thinking skills worse (Wan, 2000). On the other hand, the third year students may have been experiencing some confounding variables such as personal or family circumstance that may have affected their CCTDI scores.

The authors also discovered that the overall CCTDI score and five of the subscales scores were positively correlated with term grade point average (Wan, 2000). This is indicative of critical thinking dispositions are associated with academic success (Wan, 2000). On the other hand, there was not a significant relationship between gender, prior education, or prior work experience with CCTDI. The authors do not speculate as to why there are not significant relationships between critical thinking disposition and gender, prior education, or work experience except to say that the results in this study seem to indicate that there may not be a difference between genders which has not always been found in previous studies (Wan, 2000).

Chinese nursing students have been compared to nursing students from other countries (Mei-Ling, 2003; Tiwari et al., 2003). Mei-Ling and Hsing-Hsia (2003) compared 214 junior and senior level nursing students from Taiwan to 196 junior and senior level students from Maryland (Mei-Ling, 2003). Overall, the American students scored higher than the Chinese students on the total CCTDI score and on all of the subscales except inquisitiveness which was the highest subscale score for both groups.

However, the difference was not significant for analyticity, inquisitiveness, and self-confidence. The truth-seeking subscale score was the lowest for both the Chinese and Americans. The difference between the two groups may have been affected by the cultural and demographic backgrounds of the two groups (Mei-Ling, 2003). The American students were more mature and had more nursing experience than the Chinese. The Americans were significantly older and less than two percent of the Chinese were employed compared to more than 40% of the Americans employed. Only approximately eight percent of the Chinese had nursing work experience compared to 45.6% of the Americans. Although, the authors believe that the demographic variables may have contributed to the significant differences in the CCTDI scores, there were no significant differences between demographic variables and CCTDI scores (Mei-Ling, 2003).

An additional group compared 222 Hong Kong Chinese registered nursing students and 162 Australian enrolled nursing students (Tiwari et al., 2003). All nursing students were registered or enrolled in either a preregistration program or postregistration program depending on previous experience. The Australian nursing students showed an overall positive disposition towards critical thinking whereas, the Chinese nursing students displayed a negative disposition towards critical thinking. Both groups scored highest on the Inquisitiveness subscale and lowest on the truth-seeking subscale. The systematicity subscale score was also low for both groups indicating ambivalence towards this particular aspect of critical thinking. The two groups showed a significant difference in subscale scores for Open-mindedness and Maturity. The Chinese students showed ambivalence towards Open-mindedness and Maturity while the Australian students demonstrated a positive disposition on these two subscales.

It is suggested in this study that the Chinese Confucian philosophy plays a role in their low truth seeking scores since Confucianism emphasizes compliance (Tiwari et al., 2003). As indicated by the authors this explanation alone is not sufficient to explain the low truth seeking scores since low scores were also found in the Australian students. It is also likely that the authoritarian tradition of education plays a role in both group's low truth seeking scores. Instructors need to be good role models and support the pursuit of the best knowledge.

The ambivalence towards systematicity is concerning as it raises the question on how these students make clinical decisions (Tiwari et al., 2003). The authors suggest that problem based learning may help students arrive at a sound clinical decision. Additionally, monitoring how students make professional judgments needs to be conducted through objective and reliable assessment tools.

The Chinese students' opposition towards open mindedness and maturity may be a product of their culture (Tiwari et al., 2003). The Chinese students may not have adequate opportunity to practice being tolerant of other viewpoints, because their culture does not condone critical question and differing views.

Demographically, there was a significant difference in CCTDI scores between Chinese students over 30 years of age and those 30 years old and younger (Tiwari et al., 2003). Those students who were over the age of 30 scored significantly higher than their younger counterparts. This assessment could not be conducted with the Australian students since many did not complete the age question. The authors did not speculate as to why this difference existed but noted that it was supported by previous research.

Also, the type of nursing program (preregistration or postregistration) did not significantly impact CCTDI scores (Tiwari et al., 2003). The authors question whether the increase in critical thinking was a product of normal development and not a result of attending the programs. The generalizability of this study is limited in part because of its cross sectional design and convenience sampling. Additionally, there was less than a 50% response rate for the Australian nursing student group.

The CCTDI was also used to assess 165 Japanese nursing students and registered nurses (Kawashima, 2004). There were three groups in the study. The first group was comprised of first and third year nursing students from a four year program. The second group consisted of transfer nursing students directly enrolling into the third year. Finally, the third group was made up of registered nurses working at a general hospital. The only group to indicate positive disposition towards critical thinking was the transfer students. The other two groups scored in the ambivalence range. The registered nurses' total score was significantly lower than the transfer students. Although the scores for open-mindedness and inquisitiveness were positive for all groups, the registered nurses also scored lower on the open-mindedness and inquisitiveness subscales compared to the other two groups. Additionally, the registered nurses scored lower on the confidence subscale than the transfer student group. The overall ambivalence toward critical thinking may be impacted by Japanese education and culture much like the Chinese (Kawashima, 2004). The educational experience in Japan is based on a dominant teacher – student relationship and learning based on memorization. Another variable affecting learning could be limited teaching strategies used within the classroom. Japanese students have not been required to do a substantial amount of independent learning that

would help foster clinical thinking. In addition to the classroom experience the clinical education within the programs may not be conducive to developing critical thinking (Kawashima, 2004). Students spend more time in observation during their clinical experience than hands on. Similar to the classroom the students are not exposed to various clinical learning approaches.

The positive scores on the open mindedness, inquisitiveness, and maturity are surprising (Kawashima, 2004). It tends to suggest that Japanese nurses and nursing students are being encouraged to accept differing opinions and to consider them when making decisions. However, the authors are perplexed by these findings and suggest that further research is needed.

The lower scores of the registered nurses on a few of the subscale may be explained by the traditional values placed on Japanese nurses (Kawashima, 2004). The physician has control over treatments and limits the ability of nurses to be autonomous. The lack of opportunity for nurses to be a part of the decision making process can certainly inhibit critical thinking.

In the United States a cross sectional design study was conducted comparing critical thinking dispositions and skills of 241 sophomore and senior nursing students (McCarthy, 1999). Senior nursing students scored significantly higher on both the total CCTDI and CCTST score than the sophomores. Moreover, the seniors scored significantly higher on the truth-seeking, self-confidence, analyticity, and inquisitiveness subscales. There were no significant differences on the other three subscales between the seniors and sophomores. A positive relationship was also found between the CCTST and CCTDI.

The authors only state that the results of their study was supported by other studies and do not give any suggestions as to why the groups varied in subscale scores (McCarthy, 1999). They commented that the CCTST can be a useful tool in measuring change in critical thinking skills in a program while the CCTDI will be helpful in assessing and developing the curriculum and counseling individual students.

In 2005, a longitudinal study was conducted to compare CCTDI scores of 55 nursing students from Sophomore II level to Senior II level (Stewart, 2005). These nursing CCTDI scores were then compared to the pass rate on the NCLEX-RN exam and ERI RN standardized testing scores. The authors found that the highest CCTDI scores were during the Junior I and II levels. However, the junior level scores were not significantly different from the scores achieved during the sophomore and senior levels. GPA was correlated with different CCTDI subscales at varying time points during the students' education. For example, at the Sophomore II and Junior II levels, the open-mindedness subscale score was positively correlated with GPA. It was also discovered that the total CCTDI score and maturity subscale score were positively correlated with GPA at the Junior I level. The systematicity subscale score was found to be correlated with GPA at the Junior II levels, and inferential reasoning was positively correlated with GPA at the Senior II level. Also, the results did not show and relationship between the ERI RN and critical thinking dispositions. The most interesting finding was that the confidence subscale score was actually negatively correlated with GPA during the Senior I level.

When comparing nursing students CCTDI score with NCLEX-RN pass rates and ERI RN scores, no significant relationships were found (Stewart, 2005). There was also

no significant difference between the total mean CCTDI scores of those who passed the NCLEX-RN exam and those who did not. Even though there was not a significant difference between the mean scores, those students who did not pass the exam scored eleven points higher on the CCTDI than those who did pass the NCLEX-RN.

The potential reasons for insignificant increases in critical thinking dispositions as the students progressed through the program are differences in the students, curriculum, faculty, and environmental factors (Stewart, 2005). The ERI RN is a standardized test that assesses minimal knowledge for safe practice and not critical thinking which would have contributed to lack of relationship. In a similar fashion, the NCLEX-RN also measures knowledge which would explain the absence of a significant relationship between the pass rate on the exam and critical thinking dispositions. The authors of this study offered no theories as to why GPA was negatively correlated with confidence in Senior I level students (Stewart, 2005).

Contrary to the previous findings, another study comparing 218 nursing students' CCTDI scores to NCLEX-RN pass rates found significant differences (Giddens, 2005). This particular study was a non-experimental ex-post-facto design examining students who had enrolled in one nursing baccalaureate program between 1998 and 2001. Nursing students were assessed at the entry and exit of the program. No significant differences were found on the entry CCTDI between nursing students who failed the NCLEX-RN exam and those who passed. On the other hand, there was a significant difference on CCTDI total score, truth-seeking, open-mindedness, synthesis, and maturity subscale scores between the pass and fail groups at program exit. The pass group scores were higher than the fail groups scores overall. The authors believe that it is difficult to

discuss the relationship between the CCTDI and NCLEX-RN since the fail groups mean scores were consistent with national averages of other nursing students (Giddens, 2005). These findings suggest that further research is needed. Differences over time between the pass and fail groups and the entire sample were also assessed. When comparing the entry and exit CCTDI scores for each group there were no significant differences in scores indicating that critical thinking dispositions do not change over time. When examining the entire sample over time there was only a significant difference in entry and exit scores for the confidence subscale. The lack of change maybe due to a small sample size especially in the fail group or the short time period in which testing took place, which was less than two years (Giddens, 2005) The authors also suggest that the lack of change raises the question of whether critical thinking is a natural trait rather than a learned one (Giddens, 2005).

Critical Thinking Disposition and Learning Styles. Several studies have examined critical thinking dispositions and learning styles and all of these studies with the exception of one (Wu, 2010) have used the Learning Styles Inventory of Kolb (An, 2008; Colucciello, 1999; W. Suliman, 2006). There are four learning modes identified in the Inventory of Kolb which are, concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (An, 2008; Colucciello, 1999). Aside from the four learning modes there are four learning styles: Accommodating, Diverging, Assimilating, and Converging (An, 2008; Colucciello, 1999). Understanding what these learning modes and styles are will help in understanding the studies that compare critical thinking and to these items.

One of the studies comparing critical thinking dispositions and learning styles, utilizes the Critical Thinking Disposition Inventory (An, 2008). The Critical Thinking Disposition Inventory is comprised of twenty-six items representing constructs of Engagement, Cognitive Maturity, and Innovativeness. The sample consisted of 742 nursing students from five baccalaureate nursing programs in Korea. The nursing students ranged from first to fourth grade. The first through third grade nursing students primarily used a diverging style of learning while the fourth grade nursing students commonly used an accommodating style of learning. Numerous differences were found among the different learning styles and critical thinking dispositions. The nursing students with primarily a Diverging learning style scored significantly lower on the overall critical thinking disposition score than the other three types of learning styles. Students with Diverging learning styles prefer to be passive to watch and feel when learning making the passive learners. Passive learning inhibits the development of critical thinking which would have explained the lower critical thinking disposition scores in these students (An, 2008). Another finding was that overall critical thinking disposition score for Converging learners were significantly higher than the Accommodating learners. It makes sense that Converging learners would score higher on critical thinking dispositions since their strengths are in decision making, problem solving, and application of ideas (An, 2008).

When examining only the engagement subscale score, the Diverging group scored significantly lower than the other three groups of learning styles (An, 2008). Also, the Converging group was significantly higher than the Accommodating group on the engagement score. Overall, fourth grade nursing students had significantly higher critical

thinking disposition scores and engagement scores than the first grade nursing students. The authors reason that since engagement is developed through opportunity and experience of practicing critical thinking, it is natural that the fourth grade students scored higher than the first (An, 2008).

Relationships between critical thinking disposition and year of study and critical thinking disposition and learning styles were also assessed for the first through fourth grade nursing students (An, 2008). A significant positive correlation was found between critical thinking dispositions and year of study as well as critical thinking dispositions and learning styles. However, both of these relationships were weak. These results support the idea that Converging is the predominant learning style (An, 2008). In regards to the year of study, it is possible that differences in curriculum contribute results that differ from other studies (Giddens, 2005; Stewart, 2005).

In the United States, the CCTDI and Kolb's Learning Style Inventory were utilized to assess of 100 senior nursing students in a single baccalaureate nursing program.(Colucciello, 1999) Overall, the nursing students demonstrated a negative disposition towards critical thinking. Two groups of nursing students were compared and the lowest disposition subscale score was critical thinking self-confidence. The low score in the area of critical thinking self-confidence may have been partly explained by the tendency of most participants to over rate or under rate their ability to think critically.(Colucciello, 1999) However, as the author point out, every participant rated themselves low on critical thinking self-confidence. It is highly unlikely that all of the students would under rate their critical thinking abilities. The authors felt that this

finding regarding the senior's confidence was unacceptable and suggested the use of mentors to help students reflect when taking on a problem.(Colucciello, 1999)

Other subscales that fell below the cut-off scores for good critical thinking disposition scores were analyticity, systematicity, and inquisitiveness.(Colucciello, 1999) Conversely, the strongest scores were in the maturity and truth-seeking subscales. Although the author did not venture to explain why these differences existed, she did offer insight into how the weak analyticity scores may be increased.(Colucciello, 1999) An example for increasing analytical reasoning would be to assign students thought provoking assignments such as those that require journaling of cases in their own clinical experience. Instructors should also praise students for asking questions and support their efforts to seek the best knowledge.

Regarding the relationship between learning styles and critical thinking dispositions, a significant positive relationship was found between critical thinking self-confidence and reflective observation (Colucciello, 1999). In addition, positive relationships were found between analyticity with active experimentation as well as open-mindedness with concrete experimentation. Significant negative relationships were found between critical thinking self-confidence and abstract conceptualization, truth-seeking and active reflection, and analyticity and abstract conceptualization. In order to help students in many life situations, the author suggest providing opportunities for all students to experience each of the different learning styles (Colucciello, 1999). Exposure to each of the learning styles may help to increase critical thinking.

Suliman (2006), compared critical thinking dispositions and learning styles of two groups of nursing students at a Saudi Arabia college utilizing a prospective, non-

experimental descriptive design (W. Suliman, 2006). The sample consisted of 130 nursing students. Eighty students were enrolled in the four year conventional program offered to high school graduates (stream I) and fifty students were enrolled in the two year accelerated program for students with a college degree in one of several science fields (stream II). The overall mean score for the sample of nursing students was low. When taking a closer look, stream II students exceeded the cut off score for the CCTDI of 280 while the stream I nursing students scored below the cut off score. These differences might be explained by the demographic differences between the two groups (W. Suliman, 2006). Since Stream I students are high school students they are younger and less experience than Stream II. Also, Stream II are more independent learners because a there is a difference between high school and higher education in regards to dependent versus independent learning. The lowest subscale score for the sample was truth-seeking while higher scores were found in analyticity, self-confidence, and inquisitiveness.

Significant relationships were found between various learning styles and scores on the CCTDI (W. Suliman, 2006). CE was found to be positively correlated with analyticity, yet negatively correlated with inquisitiveness. This suggests that students who learn by feeling (CE) rely on connecting observations to theoretical knowledge and can expect the consequences (W. Suliman, 2006). At the same time these students may not care about being informed or learning how things work.

There was also a negative correlation between RO and truth seeking and systematicity (W. Suliman, 2006). The students that learn by watching (RO) would rather form an opinion than look for and evaluate new evidence. Additionally, these

students tend to be disorganized in problem solving. On the other hand, AC was positively correlated with analyticity, truth seeking, self-confidence, systematicity, and maturity. This indicates that students who learn by thinking prefer to seek the best knowledge and used reason and evidence, are orderly when solving problems, trust the reasoning process, and prudent in making judgments (W. Suliman, 2006). Finally, AE was positively correlated with inquisitiveness, indicating that students who learn by doing, desire to acquire knowledge even when it is not readily evident.

The other study to explore the relationship between learning styles and critical thinking dispositions focuses specifically on simulation-based learning style and its relationship with critical thinking dispositions (Wu, 2010). The sample consisted 409 year I and II nursing students with various ethnic backgrounds such as: Malays, Chinese, Indian, and others. Year II students demonstrated higher total CCTDI score than the year I students. However, both years I and II students displayed overall ambivalence critical thinking disposition. Ambivalence toward critical thinking may be caused by lack of exposure to various teaching and learning strategies in secondary and primary schools (Wu, 2010).

Their weakest disposition subscale score was truth-seeking and also displayed ambivalence in open mindedness, systematicity, and maturity. The Singapore students attend ten years of primary and secondary information (Wu, 2010). During their education they are exposed primarily to direct instructional method which facilitates passive learning. Passive learners do not typically challenge authority and are not open to alternative views or opinions.

Analysis indicated that both groups scored highest in inquisitiveness, analyticity, and confidence (Wu, 2010). Students had a desire to know how things worked and were able to see possible consequences. They also believed in their problem solving skills. Overall, year II students score higher in every disposition subscale and displayed a higher preference for simulation based learning compared to year I students. Preference for simulation based learning of year II students may have been due to established rapport with their classmates (Wu, 2010). The students were more comfortable in the environment and able to role play in front of their classmates. One of the limitations of this study was that the college was in the beginning stages of using stimulation based teaching. Therefore, the true benefits of this pedagogical approach may not have been realized.

Critical Thinking Dispositions and Instructional Methods. In a Pennsylvania university, thirty-six nursing students in their last term of diploma, associate, or baccalaureate programs were part of a quasi-experimental, cross-over study comparing simulation-based performance with metrics (Fero, 2010). The students completed the CCTDI and CCTST as well as a demographic sheet before being randomized into two groups. One group received videotaped vignette (VTV) and the other received a high-fidelity human stimulation assessment tool (HFHS). The break-down of CCTDI scores indicated that 25% of the nursing students had a strong critical thinking disposition, 56% average disposition, and 19.4% had a weak disposition. The lowest subscale score was for truth-seeking whereas; inquisitiveness had the highest subscale score.

Students with strong critical thinking disposition met the overall requirements on the HFHS (Fero, 2010). The expectations on the HFHS were that students would be able

to identify the clinical problem, report important information to the physician, initiate nursing interventions, and prioritize care. A relationship was found between HFHS and critical thinking dispositions, but not VTV and critical thinking dispositions. Students performing well on the HFHS were aware of potential problems, could foresee consequences, accept challenging situations, and provide care in an organized manner (Fero, 2010). On the other hand, students who performed well on the VTV were better in objectivity and displayed more intellectual curiosity and inquiry. Students who scored better on the VTV tend to perform better when they reflect on a situation while students with higher critical thinking abilities performed better with clinical scenarios. Overall, the authors suggest that the use of simulation-based performance assessments may assist with development of critical thinking skills consequently improving performance outcomes (Fero, 2010).

There are also a couple of studies comparing the effects of problem-based learning on CCTDI scores (Ozturk, 2008; Tiwari et al., 2006). The literature supports the use of problem-based education to facilitate the development of positive critical thinking dispositions. In one of these studies, 52 fourth-year Turkish nursing students at a problem-based learning institution and 95 fourth-year Turkish nursing students at an institution where traditional educational model was used were compared (Ozturk, 2008). Those nursing students from the problem-based learning institution score significantly higher on the CCTDI than those nursing student from the traditional educational models. These results support the notion that problem based learning increases the ability of students to think critically and combine theory with practice (Ozturk, 2008). However, both groups score below 280 on the total CCTDI score.

On the subscale scores, the problem-based learning groups scored significantly higher than traditionally educated group in open-mindedness and truth-seeking (Ozturk, 2008). The difference in open mindedness is probably due to the development of questioning, information seeking, discussion, and application of information that is stressed in problem based learning (Ozturk, 2008). Similarly, problem based learning emphasizes group work where student receive feedback from peers which may have attributed to the higher open mindedness score in this group.

Truth-seeking was the lowest subscale score for both groups which was a surprise to the authors (Ozturk, 2008). Faculty within the problem based learning program try to develop scenarios that would hopefully stimulate both curiosity and a desire to learn. However, non-significant difference was noted in the subscales inquisitiveness, analyticity, self-confidence, or systematicity (Ozturk, 2008).

The other study examining problem-based learning and critical thinking dispositions took place in Hong Kong (Tiwari et al., 2006). Nursing students at one university enrolled in the study during their first year and completed the CCTDI. After the initial assessment students were randomly assigned to either a problem-based learning group or lecture group. Upon completion of the lecture or problem-based learning experience, at the end of their second semester, the nursing students were administered the CCTDI again. They also completed the CCTDI after one year and two years. There were no significant differences found at the first time point before students were assigned to groups. Across the four time points the problem-based learning group ranged from ambivalent to positive disposition on the total CCTDI score while the lecture group remained ambivalent throughout all of the assessments. Like the previous study on

problem based learning, (Ozturk, 2008) the authors felt that these results indicated that problem based learning was better at increasing critical thinking dispositions than traditional lecture format (Tiwari et al., 2006).

For both groups, the highest subscale score was inquisitiveness across all time points. On the contrary, the lowest score for both groups was truth-seeking across all time points (Tiwari et al., 2006). The nursing students in the problem-based learning group scored significantly higher between the first and second assessment in the overall CCTDI score, truth-seeking, analyticity, and self-confidence. From the first to the third time points, the problem-based learning group scored significantly higher in overall CCTDI score, truth-seeking, and analyticity. Finally, from the first to the fourth time point, the overall CCTDI remained significantly higher for the problem-based learning group as did systematicity. There are many reasons as to why student in the problem based learning group score higher in total critical thinking disposition and numerous disposition subscales (Tiwari et al., 2006). Students in the problem based learning group discussed how their experience helped them analyze problems. Since they needed to combine and test new knowledge, they were more critical and objective when analyzing information related to a problem. They also had to work through the problem based learning process in an orderly manner. Again, group work allowed students to observe different thoughts and ideas.

Critical thinking disposition, Self-esteem, and Anxiety. An interesting study explored the relationship between critical thinking disposition, self-esteem, and state anxiety of Jordanian nursing students (W. Suliman & J. Halabi, 2007). A cross-sectional study design was employed to compare 175 beginning nursing students and 95 graduating

nursing students. Overall, the nursing students scored slightly higher than the cutoff score for the CCTDI. The subscales with scores over the cutoff score were analyticity, open-mindedness, systematicity, inquisitiveness, and truth-seeking. In all of these subscales the graduating students score higher than the beginners but the difference was not statistically significant. Reasons for the lack of difference may be attributed to the programs inclusion of problem solving throughout the curriculum which necessitates the use of critical thinking (W. Suliman & J. Halabi, 2007). On the contrary, there may be more too critical thinking than just problem solving. Another reason may be due to the programs teaching and learning strategies lack emphasis in the affective disposition dimension of critical thinking. The faculty need to become mentors and role models for the nursing students. Finally, the fact that this is a cross sectional design may mean that critical thinking is not properly assessed as an outcome.

Subscale scores that fell below the cutoff score were self-confidence and maturity. The only subscale score to have a significant difference between groups was self-confidence in which the graduating students scored higher than the beginners. A positive relationship was found between critical thinking and self-esteem while a negative relationship was found between critical thinking and state anxiety as well as state anxiety and self-esteem. These results demonstrate the importance of critical thinking dispositions especially critical thinking self-confidence in boosting self-esteem and decreasing state anxiety (W. Suliman & J. Halabi, 2007).

In regards to diagnosis accuracy, there is no evidence indicating a significant relationship between critical thinking disposition and accuracy of diagnosis (Paans, 2010). One hundred third and fourth year nursing students were randomly assigned to

two groups. All of the students were asked to make a diagnosis based on an assessment of a standardized simulation patient. One of the groups was allowed to use knowledge sources while the second group was not. In addition to completing the assessment of the standardized patient, nursing students were also asked to complete a knowledge inventory, the CCTDI, and Health Science Reasoning test. Analysis of the data indicated that the mean score was above the cutoff score for the total CCTDI and each of the subscales. The lowest subscale score for this sample was open mindedness while the highest was inquisitiveness. There were no significant differences in CCTDI scores between nursing students who were allowed to use knowledge sources and those who were not. It is possible that the students were not familiar with the knowledge sources used or that if they were familiar did not know how to apply the information during the assessment (Paans, 2010). It appears that students were not properly prepared to use the tools available to them.

Another finding was that there were no significant differences in the accuracy of diagnosis between those student who scored less than the overall cutoff score on the CCTDI and those who scored between 280 and 420 (Paans, 2010). Moreover, there were no significant differences in the diagnosis accuracy of those students who score below the cutoff score of 40 on any of the subscales and those who scored greater than or equal to 40 on any of the subscales. In this particular study only young nurses with relatively little experience were included. It is possible that older nurses with more experience would score higher on the CCTDI and have more accurate diagnoses (Paans, 2010).

Similarly, research has not found significant increases in critical thinking dispositions when taking online courses compared to face-to-face courses (Carter, 2008).

Carter (2008) compared pre and post coursework CCTDI scores of 34 post-RN nurses, 28 undergraduate nursing students, and 22 undergraduate sociology students (Carter, 2008). The post-RN nurses and undergraduate sociology nurses were enrolled in a university online course while the undergraduate nurses were enrolled in a face-to-face nursing course that met with an instructor once a week for three hours. The two online courses completed an online CCTDI and the face-to-face nursing class completed a hard copy version of the CCTDI. Overall, no significant differences were found between the face-to-face nursing course and the sociology online course as a function of participating in online courses. It seems that the activities and assignments were effective in sustaining students' dispositions for all three groups. For all groups, truth-seeking was the lowest subscale score for the pre-test and the post-test. However, truth seeking experienced the greatest increase which indicates that students are getting better at seeking the best knowledge which is important for evidence-based practice (Paans, 2010). Inquisitiveness was the highest subscale score for all three groups at pre and post-test. Results of this study should be viewed cautiously. The sample size was small from one institution and the groups varied in age and discipline. Also, the coursework varied greatly among the groups. Generalizability is restricted to these specific courses and sample of students.

Critical Thinking Dispositions and Clinical Judgment. Each of the critical thinking disposition subscales is instrumental in the development of students' clinical judgment. For example, inquisitiveness is the measure of a person's curiosity or desire to learn. The knowledge base for athletic training is rapidly expanding. If a student or clinician has decreased inquisitiveness then the ability to gain knowledge and practice clinically is hampered (N. Facione et al., 1994).

Systematicity is a measure of organized, orderly, focused, and diligent inquiry. Similar to nursing, an athletic trainer who demonstrates a weakness in systematicity may be susceptible to negligence in his or her practice (N. Facione et al., 1994). Similarly, the truth seeking subscale measures eagerness to see the truth, a clinician who has a disposition towards truth seeking courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support the clinician's interests or preconceived opinions. A clinician who is not disposed to truth seeking may be at risk for malpractice since these individuals may notice signs of incorrect diagnosis or a patient's changing status (N. Facione et al., 1994).

Analyticity, which is the disposition of being alert to potentially problematic situations, anticipating possible results or consequences, and prizing the application of reason and the use of evidence even if the problem at hand turns out to be challenging or difficult, is important not only to researcher, but to the athletic training clinician. A clinician that is analytical is able to relate clinical observations to his or her theoretical knowledge base (N. Facione et al., 1994). Additionally, the clinician is able to anticipate when a situation or treatment may jeopardize the safety or health of a patient.

Clinicians with a weak disposition towards open mindedness may have difficulty with different patient populations who views may differ from the clinician's views (N. Facione et al., 1994). Clinicians should be aware of their own biases. This lack of open mindedness on the part of the clinician can limit the effectiveness of the treatment intervention.

Critical thinking self-confidence subscale measures the level of trust one places in one's own reasoning processes. It would be ideal if critical thinking self-confidence

would increase as a clinician or student mastered skills. Unfortunately, some clinicians overestimate or underestimate their ability to think critically. Those who overestimate their abilities tend to act without caution while those underestimate them tend to lack leadership (N. Facione et al., 1994).

Critical thinking maturity is important for ethical decision making (N. Facione et al., 1994). Clinicians with maturity are able to see several options and are able to make decision based on the evidence, context, or standards applicable to the situation. These individuals may be better administrators and policy makers.

Assessment of Critical Thinking Skills in Undergraduate Education

Nursing. There have been many studies examining critical thinking skills in undergraduate nursing (Colucciello, 1997; Giddens, 2005; Lauder, 2001; Sizemore, 2007; Vaughan-Wrobel, 1997; Youssef, 1996). In longitudinal studies using various critical thinking skills assessment tools there is general consensus among the studies that critical thinking does not change significantly over the course of nursing programs (Bauwens, 1987; Giddens, 2005; Lauder, 2001; Sizemore, 2007; Sullivan, 1987; Vaughan-Wrobel, 1997; Youssef, 1996). Giddens and Gloeckner (2005) did not find any significant difference between entry and exit CCTST scores in one southwestern United States undergraduate nursing program between the years 1998 and 2001 (Giddens, 2005). This author felt that the lack of significant findings may have been due to the small sample of 218 participants, or the short time frame in which the study was conducted which was less than two years (Giddens, 2005). Time frame is a concern raised by another author stating that the development of critical thinking may develop over a longer period of time (Lauder, 2001). Also, the possibility exists that there is clinically significant difference in

scores even though statistical significance is lacking (Giddens, 2005). The author felt that the results bring into question the idea that critical thinking may be a natural trait and not a learned one (Giddens, 2005). Other explanations for a lack of change in critical thinking skills over time in nursing programs may be due to numerous other factors related to education. The curriculums of these students may not be properly designed to increase critical thinking (Vaughan-Wrobel, 1997). Also, the notion that students' scores should increase after completing higher level courses may not be correct (Vaughan-Wrobel, 1997). A study of nursing students completing a Bachelor of Science degree demonstrated no significant improvements in critical thinking skills despite have coursework in logic, statistics, mathematics, and research methodology which came as surprise to the researchers (Sullivan, 1987).

Another factor affecting the lack of increase in critical thinking over time may be due to some of the assessment tools used to measure critical thinking skills. For example, two studies assessed change in baccalaureate nurses' critical thinking skills overtime utilizing the WGCTA and found no differences (Bauwens, 1987; Vaughan-Wrobel, 1997). One study was conducted on nursing students at the University of Arkansas for Medical Science between the years 1993 and 1996 using the WGCTA,(Vaughan-Wrobel, 1997) and the other on nursing students from a southern Arizona program from December 1982 to May 1984 (Bauwens, 1987). The authors speculate that the WGCTA may not be the best tool to measure critical thinking in nursing and that the WGCTA focuses on logic rather than the critical thinking process (Bauwens, 1987; Vaughan-Wrobel, 1997). Although logic is needed for problem solving skills, the process of problem solving does not exert as much influence on logical critical thinking patterns

(Bauwens, 1987; Vaughan-Wrobel, 1997). The WGCTA may be a better tool for pre-screening students for entry into nursing programs (Bauwens, 1987).

Another study utilized the Cornell Critical Thinking Test (CCTT) to assess critical thinking ability in non-standard entry and standard entry nursing students (Lauder, 2001). There was no significant increase in scores from the beginning of the program till the end of the program for either group. It was noted that the CCTT may focus on a very narrow range of critical thinking ability and is unable to measure changes in critical thinking skills (Lauder, 2001). The CCTT measures just four aspects of critical thinking: induction reasoning, deduction reasoning, observation and credibility, and assumptions (Lauder, 2001).

Contradictory to the previous findings, several studies have found significant improvements in critical thinking overtime (Berger, 1984; Y. Gross et al., 1987; M. A. Miller, 1992; Sizemore, 2007). One study examining critical thinking skills in RN to BSN students found significant increases between initial and final measures of critical thinking skills scores as measured by the CCTST (Sizemore, 2007). These significant differences were found in the overall CCTST scores and the subscales of evaluation and inductive reasoning. Similarly, increases in critical thinking skills have been found in baccalaureate registered nursing program students as measured by WGCTA (Berger, 1984; Y. Gross et al., 1987; M. A. Miller, 1992). These results were expected by the authors since critical thinking is a core competency of the programs, and students must demonstrate critical thinking skills prior to exiting the program.(Y. Gross et al., 1987; M. A. Miller, 1992; Sizemore, 2007) Additionally, improvements in critical thinking over

time indicates that the nursing program has a positive effect on critical thinking skills (Y. Gross et al., 1987).

Even though most studies found no differences over time, several of the studies have examined differences between different types of nursing students (Colucciello, 1997; Y. Gross et al., 1987; Lauder, 2001; Youssef, 1996). In comparing standard and nonstandard entry nursing students at the start and end of the Common Foundation Programme, it was found that standard entry nursing students had significantly higher critical thinking scores than their non-standard entry nursing students counterparts on the CCTT (Lauder, 2001). However, this significant difference did not continue to the end of the course. The author suggests that the CCTT may be a good test to select students for entry into the program (Lauder, 2001). It appears that the program itself did not increase critical thinking skills so if critical thinking is present before the entering then program administrators may benefit from selecting students based on critical thinking capabilities before entrance into the program (Lauder, 2001).

On the contrary, in Youssef and Goodrich's (1996) study comparing critical thinking skills of traditional nursing students to accelerated nursing students from 1991 to 1993, no differences were found between these two groups on The Scale of Judgmental Ability in Nursing (Youssef, 1996). This scale partly measures critical thinking by assessing comprehension, application, analysis, synthesis, and evaluation. The authors do not have any suggestion as to why there were no differences between groups. However, there were no differences over time for these two groups either (Youssef, 1996). It is possible that this scale does not sufficiently measure critical thinking abilities either.

When comparing nursing students registered in a baccalaureate program to those in an associate program, no significant difference was found between the two groups at program entry or exit on the WGCTA (Y. Gross et al., 1987). These results surprised the authors since they believed that the two years of general education before program entry of baccalaureate nurses would increase critical thinking scores. They felt that two factors could explain the difference between scores. The first is that the associate students were drawn from the same pool of students as the baccalaureate students since the associate nurses could progress from the associate program into the baccalaureate program (Y. Gross et al., 1987). The second factor was that the two years of general education received by the baccalaureate nurses did not increase critical thinking skills especially since some courses are taught in large lecture halls which do not facilitate instructor/student interaction (Y. Gross et al., 1987).

Summary

In the beginning of the literature review the many definitions of critical thinking was explored which can make understanding critical thinking difficult. The simplified but accurate definition of critical thinking is that “critical thinking is purposeful reflective judgment focusing on what to believe or do”(P. Facione et al, 2011). It is widely accepted that critical thinking is comprised of both cognitive skills and affective dispositions. The cognitive skills include: analysis, interpretation, inference, evaluation, explanation, deductive reasoning, and inductive reasoning. The affective dispositions include: truth seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and maturity.

After defining critical thinking and discussing standardized tests used to measure critical thinking, a review of the literature on health care graduate students' critical thinking was examined. The question still remains of whether graduate health care programs increase critical thinking skills and dispositions. The literature is filled with mixed results. It appears that in general, medical education increases students' critical thinking skills over time as demonstrated in a couple of longitudinal studies. However, results varied in nursing and physical therapy. Some of the studies in these fields claim that their graduate programs do increase students' critical thinking skills, but the studies are comparing different groups of students. It may be that change in critical thinking is dependent on the education program. There does appear to be positive relationships between GPA and final grades and critical thinking as well as certification exams such as the NBME.

There were many more studies found in undergraduate health care programs on critical thinking especially in nursing. Regarding critical thinking dispositions many studies identified students as having ambivalent or negative dispositions towards critical thinking with truth-seeking subscale scores being the lowest. Many of the researchers believe that culture may be influencing dispositions towards critical thinking. In a few countries students are not encouraged to ask questions but to accept what the instructor says as an authority figure. Students in these countries are passive learners which does not facilitate critical thinking. Similar to graduate studies much of the undergraduate research indicates that there are no significant differences in critical thinking dispositions over time. Other factors that affect critical thinking dispositions are learning styles and

teaching methods. Critical thinking dispositions are also believed to be important in clinical judgment.

Many studies also indicate that programs do not increase critical thinking skills over time. In regards to the different types of nursing programs, no differences have been found between associate and baccalaureate students. The literature is inconclusive regarding the difference in critical thinking skills of traditional nursing students compared other types of nursing students.

CHAPTER III

METHODOLOGY

This chapter will discuss the methodology used to conduct this study. Subject characteristics and response rate will be discussed followed a description of the instruments used to measure critical thinking skills and dispositions as well as, the demographic survey. Finally the details of test administration details will be discussed with the chapter ending with how the data will be analyzed.

Subject characteristics

All 16 PPATP program directors at the time of this study were asked if they would be willing to forward an email to their first year students asking them to participate in this critical thinking study. Of the 16 PPATP program directors, 14 responded indicating their willingness to participate. All PPATP first year students entering their respective PPATP during the fall or summer of 2012 were solicited to participate in this study along with PPATP first year students from one institution entering the program during the fall of 2013 due to an initially low response rate ($N=182$). Of the 182 PPATP students solicited to participate, 65 responded for a response rate of 35.7% (age = 22.55 ± 1.37). The study was approved by the University Human Investigation Committee and respondents implied consent by virtue of completing and submitting the survey.

Instrumentation

The instruments for this study included a demographic survey, the CCTST, and the CCTDI. The demographic survey included twelve questions about the participants age, gender, ethnicity, length of PPATP, most recent Board of Certification score (BOC),

how many times the participant had taken the BOC, scores on each section of the Graduate Record Exam, and cumulative undergraduate grade point average. Participants were also asked to indicate how involved their undergraduate clinical instructors were with their education. Responses to this question were on a four point Likert scale of not involved, minimally involved, moderately involved, and very involved. The final question asked how much did the participants' undergraduate clinical experience contribute to their ability to think critically. These responses were also on a four point Likert scale of did not contribute, contributed minimally, contributed moderately, and significantly contributed. Examples of the demographic question can be found in Appendix D.

The California Critical Thinking Skills Test (CCTST) is a commonly used critical thinking assessment in healthcare professions (P. Facione et al., 2011; P. Facione et al., 1998). This test was created based on the APA Delphi study on critical thinking and was originally created for post-secondary assessment but has been used in high school and graduate program assessments. The test takes approximately 45 minutes to complete and contains 33 to 35 multiple choice items that include one correct answer and three to four distractors. Some of the distractors include frequently made errors while other distractors are dispositional failures. The CCTST was constructed using no technical vocabulary or any specific subject matter. Individuals should be able to understand the questions through normal maturation and having general background knowledge. This test only measures the skill aspect of critical thinking and not dispositions towards critical thinking. Critical thinking disposition is measured using the California Critical Thinking Disposition Inventory (CCTDI). Eight scores can be obtained from the CCTST (P.

Facione et al., 2011). They are an overall score and scores on seven subscales of analysis, interpretation, inference, evaluation, explanation, deductive reasoning, and inductive reasoning. Since the subscales are not independent from one another, individual scores for each scale should not be used to describe participants.

The CCTST has previous evidence of reliability and validity (P. Facione et al., 1998). Kuder Richardson – 20 internal consistency estimated ranged from .68 to .70 for both test A and test B. Content validity was established by choosing items based on a theoretical relationship to the Delphi study on critical thinking. Both sex-role and social class stereotypes were avoided, and equal number of females and males are references in order to reduce cultural and gender bias. Construct validity has been assessed for the CCTST in a couple of ways. One group of college students responded orally to the CCTST and gave justifications for their answer in order for the researcher to determine if the answer choice was selected by application of the appropriate cognitive skill (P. Facione et al., 1998). Another means to assess construct validity was to assess students improvement in CCTST scores after taking a course in critical thinking skills compared to those who had not taken a course (P. Facione et al., 1998). Students experienced a significant increase in CCTST scores after taking the critical thinking class.

Criterion validity was established through positive correlation with school success (P. Facione et al., 1998). The CCTST score has been positively correlated with the Graduate Record Exam (GRE) total score as well as the GRE analytic score, GRE verbal, and GRE quantitative. It has also been positively correlated with the ACT, CCTDI total, SAT verbal, SAT math, college grade point average, Nelson-Denny, and Watson-Glaser CTA. There have been no significant differences between males and females or races.

The next several paragraphs will identify the subscales associated with the CCTST and provides the definitions of each subscale. Each critical thinking skill also has several sub-skills. All CCTST skills and associated sub-skills are presented in table 2.

For the purposes of the CCTST, analysis is defined as, “to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, or criteria” and “to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgments, experiences, reasons, information, or opinions.” (P. Facione et al., 1998, p. 5).

The subscale of evaluation includes two definitions (P. Facione et al., 1998, p. 5). The first definition is “to assess the credibility of statements or other representations which are accounts or descriptions of a person’s perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, or other forms of representation.” The second evaluation definition on the CCTST is “to state the results of one’s reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one’s results were based; and to present one’s reasoning in the form of cogent arguments.”

The inference subscale means “to identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses, to consider relevant information and to anticipate the consequences flowing from data, statements, principles,

Table 2. CCTST Skills and Sub-skills

skills	Sub-skills
Analysis	Categorization Decoding significance Clarifying meaning Examining ideas Detecting arguments Analyzing arguments
Evaluation	Assessing claims Assessing arguments Stating the results Justifying procedures Presenting arguments
Inference	Querying evidence Conjecturing alternatives Drawing conclusions
Explanation	Stating results Justifying procedures
Interpretation	Categorizing data Determining the significance of a person's words Clarifying meaning

evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representations” (P. Facione et al., 1998, p. 5).

Explanation is the ability to explain and justify one’s reasoning taking into consideration the conceptual, evidential, methodical, and contextual considerations (P. Facione, 1990, p. 10). Explanation also includes stating results, justifying procedures, and presenting arguments. Stating the results means that a person can generate accurate descriptions or statements of the results of another’s reasoning in order to evaluate those results. Justifying procedures is justifying one’s own inferences by providing evidence used in forming that inference, while presenting arguments is being able to defend why a particular claim is accepted and be able to respond to possible criticisms.

Interpretation is to determine the exact meaning of an idea, graph, diagram, signal, sign or any text within its context. Interpretation includes skills of categorizing data and determining the significance of a person’s words. It also includes clarifying meaning (P. Facione et al., 2011).

Deductive reasoning is defined as, “the assumed truth of the premises purportedly necessitates the truth of conclusion (P. Facione et al., 1998, p. 6). In other words it is impossible for all of the premises to be true, but the conclusion false in deductive reasoning. On the other hand, inductive reasoning means “an argument’s conclusion is purportedly warranted, but not necessitated by the assumed truth of its premises.” Finally, inductive reasoning is examining information and drawing probabilistic inferences regarding what is likely true or not true. An example of inductive reasoning is disproving research hypotheses. Also, reasoning using analogies is another example of inductive reasoning (P. Facione et al., 2011).

The California Critical Thinking Disposition Inventory (CCTDI) measures a person's disposition towards critical thinking including opinions, beliefs, and attitudes towards critical thinking (P. Facione et al., 2000). Experts believe that disposition towards critical thinking to be equally important to critical thinking skills. The CCTDI includes seventy-five items measuring seven disposition scales: truth seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and judiciousness or maturity (P. Facione & N. Facione, 2010; P. Facione et al., 2000). There are nine to twelve items under each subscale in which participants are to rate to what degree he or she agrees with each statement. Answers are recorded on a six point Likert scale of "strongly agree" to "strongly disagree" with no neutral response available. Each statement represents common opinions or perceptions and uses no critical thinking vocabulary or college level content knowledge. A total of eight scores may be obtained from the CCTDI. These include an overall score and seven subscale scores. Each subscale score may range from ten to sixty while the total score ranges from 70 to 420. Subscale scores that range from ten to twenty-nine indicate low disposition scores. Scores between 30 and 40 indicate ambivalence whereas scores between 40 and 50 are positive scores and 50 to 60 are high (P. Facione & N. Facione, 2010). If a student selects a positive disposition answer, the four, five, or six points will be awarded. On the other hand, a selection of a negative disposition score will receive one, two, or three points. Individuals below 210 have low disposition towards critical thinking scores above 350 are high. The CCTDI should take participants between 15 to 20 minutes to complete.

Each of these scales has been defined for the CCTDI. The truth seeking scale measure the disposition of “being eager to seek the truth, courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one’s interests or one’s preconceived opinions” (P. Facione et al., 2000, p. 2). Open-mindedness refers to “being open-minded and tolerant of divergent views with sensitivity to the possibility of one’s own bias” (P. Facione et al., 2000, p. 2). A person who is open-minded respects rights of others to hold opinions that differ from his or her own. The next scale, analyticity, means “being alert to potentially problematic situations, anticipating possible results or consequences, and prizing the application of reason and the use of evidence even if the problem at hand turns out to be challenging or difficult” (P. Facione et al., 2000, p.3). Systematicity referes to orderly, focused, organized, and diligent inquiry while critical thinking self-confidence is the trust a person places in his or her own reasoning process. The inquisitiveness scale assesses intellectual curiosity. An inquisitive person is defined as a person who desires to be well-informed, understand how things work, and wants to learn even if the benefits gained are not immediate. Finally, maturity measures how adapt a person is to make reflective judgments. This scale assesses both cognitive maturity and epistemic development.

Validity and reliability have been well established for the CCTDI (P. Facione et al., 2000). Face validity has been established by college instructors indicating that the items on the CCTDI are applicable to the target dispositions. Also, the intent of the CCTDI is not to assess critical thinking skills. It may be that a participant values objectivity but is unable to achieve objectivity.

The CCTDI has also been correlated to “openness to experience” and “ego-resiliency.” The scales of truth seeking, open-mindedness, critical thinking confidence, and inquisitiveness are all positively correlated with “openness to experience” (P. Facione et al., 2000). On the other hand, all of the scales were positively correlated with “ego-resiliency.” Additionally, the CCTDI has been shown to be positively correlated with ACT and SAT-Verbal scores.

Research Design

This research design is a correlational design. The purpose of correlational research design is to explore relationship among variable that were not manipulated (Fitzgerald, Rumrill, & Schenker, 2004). In this study, age, most recent BOC score, GRE scores, and cumulative undergraduate grade point average were collected which could not be manipulated. Correlational statistics calculations result in scores ranging from -1 to +1. The closer a correlational coefficient is to -1 or +1, the stronger the relationship. Negative values indicate and negative relationship and positive values indicate a positive relationship. A value of zero would indicate no relationship. One of the major concerns in interpreting correlational data is the existence of multicollinearity. Multicollinearity occurs when two variables are highly correlated with each other. High correlations mean that the variables are giving virtually the same information and should be removed from regression analyses.

Testing Procedure

All PPATP fourteen program directors were contacted in January 2012 asking them to forward an email inviting all PPATP students in their first year of the program to participate in the study. The program directors were also asked to provide the number of

students who were eligible for the study and would receive the initial email. This initial email explained the importance of the study and informed the potential participants how to access the website to complete the CCTST and CCTDI. It also indicated that the study was approved by the University Human Investigation Committee, all responses were confidential, and consent was implied through completion and submission of the test.

Participants logged onto the insight assessment website to begin their profile and answer the demographic questions. After creating the profile and finishing the demographics the participants could choose which survey to complete first. Once the survey was begun, the participant had forty-five minutes to complete the CCTST and thirty minutes to complete the CCTDI. The results could be saved after completing one survey, and the participants could resume the second survey at their convenience. The scores were tallied on the website and a results page was provided to the participant as well as the author. After completing the survey students were contacted and offered a ten dollar gift card to the business of their choice upon e-mailing the primary investigator their mailing address. Data collection occurred over a six month period at the beginning of the fall 2012 semester. Three email reminders were sent to each participant approximately one week apart via email.

Data Analysis

The independent variables were age, board of certification score, all graduate record exam subscale scores, and undergraduate cumulative grade point average. It is important for educators to be able to identify factors that may indicate whether a student is a good critical thinker or not. Many of these independent variables may be used as entrance criteria to universities and athletic training programs. Assessing whether there

are relationships between these independent variables and critical thinking skills and dispositions could lead to better decision making about which criteria to include when looking for students who are apt to think critically and have good critical thinking skills. Overall scores for the CCTST, CCTDI, and demographics were calculated and descriptive statistics were used to determine means, standard deviations, and frequencies. Not all participants chose to provide all of the demographic information or complete both the CCTST and CCTDI.

Multiple Imputations. In order to address any bias that may be introduced as a result of missing data, multiple imputation was used to create five imputed data sets from the available data. Both graduate record exam, analytical writing score, and most recent BOC score variables were missing 20 (30.8%) values. The graduate record exam quantitative reasoning score and verbal reasoning score variables were missing 19 (29.2%) values. CCTST overall score and each of the subscale scores had 7 (10.8%) missing data points, and the CCTDI overall score and all subscale scores had less than ten percent of the data missing. All available data was used to create five imputed data sets. Missing data can be classified into three different missing data mechanisms (Baraldi & Enders, 2010). This mechanism includes three classifications, missing data completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). Data is considered MCAR if the missing data is not systematic and unrelated to another study variable. Data is MAR if the missing variable is related to other measured variables in the study. Finally, data is considered MNAR if the probability of the missing data is related to the values that are missing, In this study, missing data was assumed to be missing at random (MAR) and the imputation method utilized was Markov chain Monte

Carlo (MCMC) (Version 21.0, SPSS Inc Chicago, IL). After imputed values were generated the values were examined to ensure that the imputed scores fell within the possible range of values for that particular variable. Any variable with imputed scores outside of the possible range of scores was re-imputed with high and low value constraints placed.

Cronbach's Alpha. Cronbach's alpha coefficient measures internal consistency and is important to include in studies since it is an estimate of reliability (Connelly, 2011). All items on any particular instrument should measure a single attribute so all items on the scales or subscales should be related or correlated to one another. In order to assess internal consistency of both the CCTST and the CCTDI Cronbach's alpha coefficients were used. Cronbach's alpha coefficients greater than .9 are considered excellent, greater than .8 is good, greater than .7 is acceptable, greater than .6 is questionable, greater than .5 is poor, and less than .5 is considered unacceptable (George, 2003).

Pearson Product Moment Correlation. Karl Pearson developed the Pearson's correlation coefficient in 1895 (Rodgers & Nicewander, 1988). This was the first and most widely used measure of correlation. The Pearson product moment correlation coefficient is labeled as r which measures the closeness or relationship of variables and is limited as a range of -1 to +1. The equation for r is the centered and standardized sum of cross-product of two variables (Rodgers & Nicewander, 1988). The Pearson's product moment correlation is appropriate to use when the data is interval or ratio (Fitzgerald et al., (2004). A Pearson product moment correlation coefficient was used to

assess relationships between the CCTST and CCTDI as well as between the CCTS and BOC exam scores, GRE scores, and previous semester GPA.

Regression. In correlational studies researchers may use that data for predictive or explanatory purposes (Fitzgerald et al., 2004). If a prediction is desired, then the researcher gathers data on one or more predictor variables and a single criterion variable that is hypothesized to occur after the predictor variable(s). On the other hand, explanatory studies involve the use of theoretically chosen predictor variables that are hypothesized to account for the variance in the criterion variable. How the variables are measured will determine the type of regression used. If the criterion variable is interval or ratio and the the predictor variables interval or ratio, ordinal, or nominal then a simple/multiple linear regression may be used (Fitzgerald et al., 2004). If the criterion variable is ordinal and the predictor variable is interval or ratio, ordinal, or nominal then log-linear analysis or multinomial analysis is used. Lastly, if the criterion variable is nominal and the predictor variable interval or ratio, ordinal, or nominal then simple/multiple logistic regression is used. In order to determine which demographic characteristics are significant predictors of CCTST and CCTDI total scores a multiple linear regression was utilized. All data was analyzed using SPSS (Version 21.0, SPSS Inc Chicago, IL) with an alpha level of .05.

CHAPTER IV

RESULTS

The results chapter will cover the results of the demographic questions and scores for the CCTST and CCTDI including means and standard deviations. A frequency table for the categorical results of the CCTST total score and subscale scores along with the CCTDI subscale scores are presented in this chapter. The results of the internal reliability of the CCTST and CCTDI and the Pearson's product moment correlations between selected independent variable and dependent variables are also presented. Finally, the results of the regression analyses of predictor variables for both the CCTST and CCTDI are presented.

Demographics. Demographics for the first year PPAT students can be found in table 3. Additional demographics for the GRE subscales, BOC score, and undergraduate cumulative GPA are provided in table 4. Overall, the PPATP students felt that their undergraduate clinical preceptors were either moderately involved or very involved with their education in athletic training. Seventeen of the students (26.2%) indicated that their undergraduate clinical instructors were moderately involved while 48 (73.8%) indicated that their undergraduate clinical instructors were very involved.

In contrast, when asked about how much their undergraduate clinical experience contributed to their ability to think critically, one student (1.5%) reported that his or her clinical experience did not contribute to personal critical thinking ability. Four students (6.2%) felt that their clinical experience contributed minimally, twenty-two (33.8%) felt that the clinical experience contributed moderately, and thirty-eight (58.5%)

Table 3. Participant Demographics (N=65)

Characteristic	Number	Percentage
Ethnicity		
Black, African American	4	6.2
White, Caucasian, Anglo American	56	86.2
Asian, Asian American, Pacific Islander	2	3.1
Hispanic, Latino, Mexican American	2	3.1
Other	1	1.5
Gender		
Male	24	36.9
Female	41	63.1
Length of program		
1 year	18	27.7
2 year	47	72.3
Number of times taking BOC		
One time	61	93.8
Two times	4	6.2

Table 4. Demographics

Variable	Mean \pm Standard Deviation	Score Range
BOC score	578.20 \pm 54.32	200-800
GRE Verbal Reasoning	151.26 \pm 6.02	130-170
GRE Quantitative Reasoning	149.91 \pm 6.75	130-170
GRE Analytical Writing Score	3.92 \pm .57	0-6
Undergraduate GPA	3.56 \pm .28	

reported that their clinical experience contributed significantly to their critical thinking ability.

Descriptives. Fifty-eight (89%) of the PPATP students completed the CCTST. The overall mean score indicates that PPATP students have moderate critical thinking skills (73.14 ± 9.87). Scores also fell in the moderate critical thinking skills range for all seven subscale categories. The PPATP students were strongest in the interpretation subscale and weakest in evaluation. The breakdown of each subscale score mean and standard deviation is provided in Table 5. The number and percentage of participants for each CCTST subscale category can be found in Table 6.

For the CCTDI, 63 (97%) of the PPATP students completed the test. The students overall mean score was 299.59 ± 25.27 . Overall, students had a positive disposition towards critical thinking. Means, standard deviations, and categorical score for each CCTDI subscale can be found in Table 7. The percentage of participants in each category for all CCTDI subscales can be found in Table 8.

Internal Consistency. Cronbach's alpha coefficients were used to measure internal consistency of both the CCTST and the CCTDI. The internal consistency of the CCTST was .96 which is considered excellent. (George, 2003) The Cronbach's alpha for the CCTDI is acceptable at .79. (George, 2003)

Correlations. Pearson's product moment correlations were used as a preliminary analysis to assess relationships among various variables related to the research hypotheses one through four. Significant positive results were expected between BOC and CCTST total scores, GRE scores and CCTST total scores, cumulative undergraduate GPA and total CCTDI score, and CCTST total score and CCTDI total score. Results

Table 5. CCTST Subscale Averages (N=58)

Scale	Mean \pm Standard Deviation	Category
Induction	76.78 \pm 9.73	Moderate
Deduction	73.31 \pm 9.73	Moderate
Analysis	75.60 \pm 11.09	Moderate
Inference	75.36 \pm 9.61	Moderate
Evaluation	71.28 \pm 9.67	Moderate
Interpretation	78.60 \pm 12.25	Moderate
Explanation	72.28 \pm 11.95	Moderate

Table 6. Number of participants in each category for CCTST scores (N=58)

CCTST Scale	Not Manifested (50 – 62)	Weak (63-69)	Moderate (70-78)	Strong (79-85)	Superior (86-100)
Induction	6(10.3%)	7(12.1%)	14(24.1%)	22(37.9%)	9(15.5%)
Deduction	7(12.1%)	11(19.0%)	20(34.5%)	14(24.1%)	6(10.3%)
Analysis	8(13.8%)	7(12.1%)	17(29.3%)	16(27.6%)	10(17.2%)
Inference	7(12.1%)	11(19.0%)	14(24.1%)	14(24.1%)	12(20.7%)
Evaluation	10(17.2%)	13(22.41%)	22(37.9%)	7(12.1%)	6(10.3%)
Interpretation	6(10.3%)	9(15.5%)	8(13.8%)	12(20.7%)	23(39.7%)
Explanation	16(27.6%)	7(12.1%)	15(25.9%)	11(19.0%)	9(15.5%)
Overall	8(13.8%)	12(20.7%)	14(24.1%)	18(31.0%)	6(10.3%)

Table 7. CCTDI Averages

Subscale	Mean \pm Standard Deviation	Category
Truth-seeking	37.33 \pm 5.12	Ambivalent
Open-mindedness	42.05 \pm 5.22	Positive
Analyticity	44.43 \pm 7.71	Positive
Systematicity	41.43 \pm 6.4	Positive
Confidence in Reasoning	44.19 \pm 5.92	Positive
Inquisitiveness	46.13 \pm 5.7	Positive
Maturity of Judgment	42.35 \pm 25.27	Positive

Table 8. Number of participants in each category for CCTDI scores (N=63)

CCTDI Scale	Strong Negative (10-19)	Negative (20-29)	Inconsistent/Ambivalent (30-39)	Positive (40-49)	Strong Positive (50-60)
Truth-seeking	0	2(3.2%)	37(58.7%)	24(38.1%)	0
Open- mindedness	0	1(1.6%)	17(27.0%)	40(63.5%)	5(7.9%)
Analyticity	0	0	7(11.1%)	48(76.2%)	8(12.7%)
Systematicity	0	3(4.8%)	23(36.5%)	29(46.0%)	8(12.7%)
Confidence in Reasoning	0	0	12(19.1%)	39(62.0%)	12(19.1%)
Inquisitiveness	0	0	9(14.3%)	36(57.1%)	18(28.6%)
Maturity of Judgment	0	0	20(32.0%)	36(57.1%)	7(11.1%)

demonstrated no significant relationship was found between the most recent board of certification score and CCTST total score ($r=.12, p=0.41$). There was also no significant relationship found between CCTST total score and GRE verbal reasoning score ($r=.04, p=0.84$), GRE quantitative reasoning score ($r=.20, p=0.35$), and GRE analytical writing score ($r=-.07, p=0.68$). No significant relationship was found between undergraduate cumulative grade point average and CCTDI total score ($r=.06, p=0.66$). Finally, no significant relationship was found between CCTST total score and CCTDI total score ($r=.22, p=0.02$).

Regressions. In the last hypothesis cumulative GPA and GRE scores were expected to be significant predictors of CCTST total scores. A multiple linear regression was utilized to determine if the independent variables, age, length of program, most recent BOC score, number of times taking the BOC, undergraduate GPA, and GRE subscales were predictors of CCTST overall scores. The result was that these variables were not significant predictors of CCTST overall scores ($R^2=.565, F=2.276, df=8, 14, p=.085$). These same independent variables were also used to determine if they were significant predictors of CCTDI total score. The results were that these independent variables were also not significant predictors of CCTDI total score ($R^2=.333, F=.937, df=8, 15, p=.515$).

CHAPTER V

DISCUSSION

The purpose of this study was to assess first year PPATP students' critical thinking skills and dispositions utilizing the CCTST and CCTDI. Fourteen of the sixteen programs were solicited to participate in the study. Students completed the demographic survey, CCTST, and CCTDI online. This chapter will briefly review the results and compare the findings of this study to previous research and discuss the implications of these findings to athletic training.

Results indicated that a majority of PPATP students felt that their undergraduate clinical instructors were either moderately involved or very involved in their athletic training education. Additionally, a majority of students felt that their clinical experience contributed moderately or significantly to their critical thinking ability. Regarding the hypotheses, no significant relationships between CCTST total score and BOC score, GRE subscale scores, or CCTDI total score. Also, no significant relationships were found between CCTDI total score and cumulative GPA. The results of the regression analysis demonstrated that the independent variables did not significantly predict total critical thinking skills scores or critical thinking disposition scores.

CCTST

Overall, first year PPATP students had moderate overall critical thinking skills and moderate skills on all seven subscale scores. Although previous versions of the CCTST have been scored on different scales, the most current user's manual provides categorical cut-off scores for all past versions of the CCTST (N. Facione, 2013). When CCTST total scores of first year PPATP students were compared to first year graduate

nursing students, PPATP students scored lower than nursing students (McMullen, 2009). These nursing students displayed critical thinking skills in the strong range. However, all of the graduate nursing students were from one program and may have been exceptional students in thinking critically.

Generally, physical therapy students also had strong total critical thinking skills (Vendrely, 2005; Wilson, 2000; Zettergren, 2004). However, it should be noted that some of the participants assessed were fourth and fifth year students (Zettergren, 2004) or from a single institution (Vendrely, 2005; Wilson, 2000; Zettergren, 2004). This sample of first year PPATP students' scores were similar to a group of third year physical therapy students from one institution who also scored moderately in total critical thinking score (Zettergren, 2004).

There were some studies on baccalaureate nursing students (McCarthy, 1999; Profetto-McGrath, 2003), nursing diploma graduates (Sorensen, 2008), and registered nurse (RN) to BSN program students (Sizemore, 2007) who also scored in the moderate range on the CCTST overall score. Once again, most only assessed participants at one institution or program (McCarthy, 1999; Profetto-McGrath, 2003; Sizemore, 2007) therefore making it difficult to generalize to the nursing student population.

Additional studies assessing BSN nursing students (Fero, 2010; Sorensen, 2008), diploma nursing students and associate degree nursing students reported CCTST scores in the strong range (Fero, 2010). All of these nursing students had either graduated (Sorensen, 2008) or were in their final semester of study (Fero, 2010). The additional experience may have positively influenced their scores. On the other hand, a Korean sample of senior nursing associate degree students, BSN students, and RN to BSN

students scored in the weak range on the CCTST overall score which may have been affected by an authoritarian style of education where students do not get as much opportunity to practice their critical thinking skills (Shin, 2006).

In regards to athletic training education, no published studies were found measuring critical thinking skills in PPATP students or professional athletic training program students. Professional athletic training students at the baccalaureate level are involved in vigorous clinical experiences throughout their two to three years and need to develop their critical thinking skills quickly. In many cases, PPATP students have less than a year of additional experience compared to the baccalaureate professional students. PPATP students are typically the top of their professional programs and enter into a PPATP to gain more in depth knowledge in athletic training. The PPATP students must adapt to a new didactic and clinical environment and learn to become more autonomous in their clinical decision making.

It is not a surprise that total critical thinking skills scores was not related to the BOC total score. The BOC measure knowledge in the domains of athletic training and does not evaluate the students' ability to analyze problems they may encounter with a patient, nor does the student have to explain their reasoning behind answers given on the BOC. There is no inductive or deductive reasoning required on the BOC as well.

The GRE although may require some critical thinking ability through deduction, analysis on the analytical writing section, the GRE requires background knowledge in mathematics and English order to be able to perform well on the quantitative reasoning section and verbal reasoning section. Without this background knowledge students who are good critical thinkers otherwise may still perform poorly.

Because critical thinking is important for good clinical decision making, PPATP directors and preceptors need to find ways to improve critical thinking skills of PPATP students as this is the students' first experience with autonomous clinical decision making as a credentialed athletic trainer. The program directors and preceptors need to be knowledgeable in critical thinking and be able to evaluate their programs for components of critical thinking. Some suggestions for increasing critical thinking skills are reflective journals, debates, socratic questioning, research papers (Profetto-McGrath, 2003; Fero, 2010), standardized patients (Smithburger, Kane-Gill, Ruby, & Seybert, 2012) and simulation-based performance assessments (Smithburger et al., 2012). Clinical reflective journals in athletic training are easy to implement and can include unique patient cases experienced by the student. Reflective journaling could also include clinical questions related to the students' clinical experience with answers supported by current research. Debate teams can be established to present differing viewpoints on current issues in athletic training. Students should be instructed to find the best available evidence to support their viewpoint during the class debate. Athletic training students should be encouraged to ask questions in both the didactic and clinical setting and faculty, clinical preceptors should be instructed to welcome these questions. Research papers are not only a good way to increase knowledge but can be used to teach literature searching skills as well as how to appraise the literature. Standardized patients can be utilized in athletic training utilizing another role playing educator or a person educated about the specific injury, illness, or disease being assessed. The students interview and assess the role player to determine the problem (Smithburger et al., 2012). Simulations are conducted using mannequins that have physiologic responses to different clinical scenarios

depending on how the educator programs them (Smithburger et al., 2012). Mannequins allow students to watch the effects of their interventions. Courses should be developed to promote problem solving and critical thinking skills should be implemented across the entire curriculum rather than in isolated units (Drennan, 2010).

In nursing, contextual learning intervention has been developed as a way to increase critical thinking (Forneris & Peden-McAlpine, 2009). The contextual learning interventions include four educational components that may be applied to athletic training. These educational components are narrative reflective journaling, individual interviews, preceptor coaching, and leader-facilitated discussion groups. Narrative reflective journaling requires the novice nurse to reflectively think while recalling and documenting narrative stories. Individual interviews allow preceptors to mentor and support the novice nurse's critical thinking process. Preceptor coaching is engaging the novice nurse to use contextual learning on a daily basis and incorporate critical thinking into daily practice. The preceptor may use reflection and dialogue about patient care with their mentees to enhance critical thinking skills (Forneris & Peden-McAlpine, 2009).

CCTDI

Our results indicated that first year PPATP students scored in the positive range for each CCTDI subscale with the exception of the truth-seeking subscale which was in the ambivalent/inconsistent range. These results were supported by one study of graduate occupational students entering into a master's level program who also scored positively on all subscales except truth-seeking (Lederer, 2007). In undergraduate education, there have been numerous studies in nursing that have also found all CCTDI subscale scores to be positive with the exception of truth-seeking which was also in the

inconsistent/ambivalent range (Carter, 2008; Mei-Ling, 2003; Ozturk, 2008; Profetto-McGrath, 2003; Tiwari et al., 2003; Wangenstein, 2010). Most of these studies were done in other countries such as: Canada (Carter, 2008; Profetto-McGrath, 2003), Turkey (Ozturk, 2008), Australia (Tiwari et al., 2003) and Norway (Wangenstein, 2010). One author suggests that the reason for the low truth-seeking score in nursing is that some nurses refuse to examine new information and continue to treat based on what has been done in the past (Wangenstein, 2010). Additionally, many students assume a passive learning role during lecture style classes which may contribute to the low truth-seeking scores (Profetto-McGrath, 2003). Athletic training educators should avoid a didactic curriculum that is primarily a lecture format and utilize a more problem based approach. Students should be active in classes through discussions and encouraged to ask questions and critically appraise new information. Additionally, clinical preceptors for the educational program should also model truth-seeking and encourage their students to ask questions in the clinic.

Several studies in undergraduate nursing found all of the CCTDI subscales to be in the positive range (Fero, 2010; Ozturk, 2008; Sizemore, 2007). Students from these studies came from associate programs, diploma programs (Fero, 2010), baccalaureate programs (Fero, 2010; Ozturk, 2008) and RN to BSN programs (Sizemore, 2007). In the study of Turkish study, two groups of undergraduate students in either a traditional lecture based format institution or a problem based learning format institution were compared (Ozturk, 2008). Students in the problem based learning format scored better than the students in the traditional lecture format with all subscale scores being in the positive range. However, only the subscales of open-mindedness and truth-seeking were

significantly better. The authors believed that the problem-based learning approach emphasis on developing the students' ability to ask questions and seek information as well as improve their discussion and application of new information contributed to higher truth-seeking scores compared to the other group (Ozturk, 2008). In the study conducted by Ozturk (2008), not only did students score in the positive range on the CCTDI subscale scores, the inquisitiveness score for the sample was in the strong positive range. (Fero, 2010). As evidenced by the study conducted by Ozturk (2008), a more problem-based learning approach could be beneficial in athletic training education for increasing truth-seeking scores. Encouraging questions, increasing ability in seeking information, and improving discussion were also identified previously as ways to increase critical thinking skills. A problem based learning approach throughout the athletic training curriculum may not only be instrumental in raising truth-seeking scores but also improving athletic training students' overall critical thinking skills as well.

There are still more studies that refuted our findings with lower scores on multiple subscales (Colucciello, 1999; Mei-Ling, 2003; Tiwari et al., 2003; Tiwari et al., 2006; Wan, 2000). Despite the lower scores in these studies, all subscale scores were either the positive or ambivalent/inconsistent range. Most of these studies were also conducted in other countries. A majority of them were in China (Mei-Ling, 2003; Tiwari et al., 2003; Tiwari et al., 2006; Wan, 2000), South Korea (Shin, 2006) and Saudi Arabia (W. Suliman & J. Halabi, 2007). Authors studying Chinese and South Korean students agree that the influence of Confucian philosophy and authoritarian tradition have contributed to lower scores on some of the critical thinking disposition scales (Mei-Ling, 2003; Tiwari et al., 2006; Wan, 2000). Confucian philosophy encourages compliance, so students tend to

passive learners instead of seekers of truth (Tiwari et al., 2003; Wan, 2000). The authoritarian tradition in educational institutions can stifle a student's creativity (Shin, 2006; Tiwari et al., 2003). In athletic training, one published study was found that investigated critical thinking dispositions in baccalaureate athletic training students from three athletic training professional programs (Leaver-Dunn, 2002). Similar to our results, students in this study also scored in the positive range in all subscales with the exception of truth-seeking which was in the inconsistent/ambivalent range. It was suggested that a possible reason for the lower scores in truth-seeking in this sample may be due to a competency and fact driven education process in athletic training. Students are tested on the facts which may lead students to be focused on the right answer as opposed to knowing why the answer is correct (Leaver-Dunn, 2002).

An ambivalent/inconsistent score in truth-seeking is concerning since truth-seeking is considered to be the basis for evidence-based practice (Carter, 2008). A new content area of evidence-based practice has been added to the fifth edition of the *Athletic Training Education Competencies* (NATA, 2011) which means professional level athletic training programs must address evidence-based practice within the educational program. The addition of evidence-based practice competencies should help future athletic training students score better on the truth-seeking subscale.

Part of the reason for the ambivalent/inconsistent score in the area of truth-seeking in athletic training may also be a lack of emphasis on critical thinking within the baccalaureate professional athletic training educational program. Not only is there room for improvement in just the area of truth-seeking but in all critical thinking disposition subscales. Students must be disposed to use the critical thinking skills they have learned

in order to be successful (Wangensteen, 2010). Since athletic training program educators and preceptors have significant influence on their students, one of the most important things they can do to increase critical thinking dispositions in their students is to model these dispositions both in and out of the classroom and clinic (Lederer, 2007). Educators also need to evaluate their programs to make sure that assignments that foster positive critical thinking dispositions are incorporated into their learning experience (Colucciello, 1997; Profetto-McGrath, 2003). Truth-seeking may be developed by encouraging students to constantly evaluate new information and be open to counter evidence. Self-confidence can be fostered by using reflective observation when performing a task or dealing with a problem situation (Colucciello, 1999). Journaling of case studies that students experience along with praising students for asking questions and seeking the best knowledge can increase analyticity (Colucciello, 1999). Increasing dispositions toward critical thinking especially in the area of truth seeking can help the profession of athletic training become more successful in implementing evidence-based practice which should lead to better patient care.

Post-professional athletic training programs must build on the athletic training foundation provided by the professional programs and continue to create opportunities for developing critical thinking dispositions, especially in truth-seeking. Truth-seeking should be developed in PPATPs through a guided evidence-based practice approach to clinical practice. Program directors need to implement objective measures to ensure that critical thinking is being developed within the program and make curricular changes based on their findings.

Since outcome measures are important for program accountability, athletic training educators may be reporting critical thinking outcomes of their programs. The difficulty in using published assessment tools is that they cost money to implement. It may be necessary to develop assessment tools to analyze both critical thinking skills and dispositions in athletic training students. In this study, total critical thinking scores and disposition scores were not related. Increasing athletic training students' dispositions towards critical thinking may not translate to increase in critical thinking ability so methods for assessing both are needed.

The results of this study indicate that BOC scores should not be reported as an outcome measure of students' ability to think critically, nor should GRE scores be used as a way to determine a student's ability to think critically as these are not related to critical thinking skills. If educators are interested in admitting students who are good critical thinkers then further exploration of variables related to critical thinking is needed.

Limitations

The CCTST and CCTDI are self-reported measures and participants may have clicked through the online surveys without reading the questions in order to receive the gift card reward. Scores were reviewed to ensure that no demographics outside the possible ranges were entered or that scores were uncharacteristically low. Participants used personal computers to take the tests so the environment in which the tests were taken could not be controlled and distractions may have impacted some of the results. However, the tests were not timed and participants could save the survey and resume where they left off at a later time. Some of the participants reported having difficulty accessing the website to complete the CCTST and CCTDI. Participants were told to

ensure that most up-to-date version of Java software was installed on the computer being used to complete the survey. Having to download additional software may have resulted in some students from not participating.

CHAPTER VI

SUMMARY

Critical thinking is purposeful reflective judgment focusing on what to believe or what to do. Critical thinking is comprised of critical thinking skills including, analysis, interpretation, inference, evaluation, explanation, deductive reasoning, and inductive reasoning, and critical thinking dispositions comprised of truth-seeking, open-mindedness, analyticity, systematicity, confidence in reasoning, inquisitiveness, and maturity of judgment. Although, PPATP programs are required to develop critical thinking skills there has not been any published studies examining critical thinking outcomes in these programs. Our purpose for this study was to assess critical thinking skills and critical thinking dispositions of first year PPATP students utilizing the California Critical Thinking Skills Test and the California Critical Thinking Disposition Inventory.

We found that PPATP first year students have moderate critical thinking skills and had a positive disposition on all subscales of the CCTDI with the exception of truth-seeking which was ambivalent/inconsistent. Critical thinking skill scores were generally below scores of graduate nursing and physical therapy students, indicating the need for improvement in athletic training. We did not find any significant relationship between critical thinking skills and BOC scores or GRE scores. We also did not find a significant relationship cumulative undergraduate GPA and critical thinking disposition, nor did we find a significant relationship between the CCTST and CCTDI. In this study, age was the only significant predictor of critical thinking skills. Whereas, involvement of the clinical

instructor and PPATP program length were significant predictors of critical thinking disposition.

Implications for educators and clinical preceptors are to become knowledgeable in critical thinking and evaluate their programs for inclusion of assignments that foster components of critical thinking. Educators and clinical preceptors need to develop a curriculum that increases critical thinking skills possibly through reflective journals, debates, socratic questioning, and research papers. Additionally, Athletic training program directors should avoid a didactic curriculum that is primarily a lecture format and utilize a more problem based approach to create positive dispositions towards critical thinking. Students should be active in classes through discussions and encouraged to ask questions and critically appraise new information. It is also important that athletic training students are encouraged not to simply memorize correct answers to questions on tests but to understand why answers are correct. Furthermore, clinical preceptors and faculty for the educational program should also model critical thinking, especially truth-seeking which first year PPATPs demonstrated weakest scores. Finally, PPATP directors need to implement a system for objectively assessing critical thinking skills and dispositions in their programs.

Future research should examine critical thinking skills and dispositions among other members of the athletic training community such as: undergraduate students, entry-level master's students, educators, preceptors, and clinicians. Additional research is warranted to determine what other factors may predict a student's disposition towards and ability to think critically. A longitudinal study examining the effects of the PPATP students' critical thinking skills and dispositions would be beneficial. Also, research to

find effective educational strategies to increase critical thinking disposition and skills in athletic training students is needed.

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APPENDIX A
SAMPLE LETTER TO PPATP DIRECTORS

Dear (*PPATP director name*),

My name is Jessica Walter, and I am a doctoral student at Old Dominion University. I am writing to ask for your assistance on my research for my dissertation. My research is assessing first year post-professional athletic training education students' critical thinking skills and dispositions. This research has been approved by the Old Dominion investigation committee.

Through this study I hope to gain a baseline measure of critical thinking in post-professional athletic training students and to determine what characteristics about the students are predictors of critical thinking ability. This information would be valuable in assisting program directors in making decisions about admission into the post-professional athletic training program.

If you would be interested in supporting me in this endeavor, please respond to this email, and I will send you another email to forward to your first year post-professional students with the link to the survey. The survey contains both the California Critical Thinking Skills Test and the California Critical Thinking Disposition Inventory. After one week, I will send one email reminder for you to forward to the students. I really appreciate you taking the time to help me. Your participation is vital to the success of this research. If you have any questions, please contact myself or Dr. Bonnie Van Lunen.

Sincerely,

Jessica M. Walter, MEd, ATC
Doctoral Student
Old Dominion University
JessicaMWalter@gmail.com

Bonnie Van Lunen, PhD, ATC, FNATA
Graduate Program Director, Post-Professional Athletic Training Education
Graduate Program Director, Human Movement Science
Old Dominion University
School of Physical Therapy
3118B Health Sciences Building
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APPENDIX B

SAMPLE PPATP STUDENT EMAIL

Dear student,

Congratulations on your acceptance into a post-professional athletic training education program! I am a doctoral student in the Human Movement Science program at Old Dominion University. I am writing to request your assistance with my research. As part of my research, I am assessing critical thinking in first year post-professional athletic training education students. This study has been approved by the ODU Investigation Committee. Your participation is appreciated and vital to the success of my research.

Below you will find a link that will take you to the survey website. Once you click on the link, click on "test taker login" at the top of the page and insert the login and password provided below. This assessment will take approximately one hour to complete. Answers will remain confidential and no information will be distributed that may identify you or your post-professional athletic training program. By completing and submitting the survey, it is assumed that you consent to participate in this study. At the end of the survey you will be able to see your results and will be submitted for a chance to win one of two twenty-five dollar visa gift cards. If you have any questions, please do not hesitate to contact either myself or Dr. Bonnie Van Lunen. Again, thank you for your participation!

Link: *(Link URL)*

Login: *(login username)*

Password: *(password)*

Sincerely,

Jessica Walter, MEd, ATC
Old Dominion University
Doctoral student
JessicaMWalter@gmail.com

APPENDIX C

SAMPLE STUDENT REMINDER EMAIL

Dear Student,

This is a friendly reminder to please complete the critical thinking survey for my dissertation research. Your participation is extremely important for the success of my research and for my graduation! I have posted the link below to the website. At the top of the page in the right corner click on "Test Taker Login" and enter the user name and password provided below. Upon completion you will be able to see your results. You will also be entered to win one of two 25 dollar visa gift cards. Please have the survey completed by Oct 11, 2012. Thank you in advance for your participation! It is very much appreciated! If you have any problem viewing the survey be sure that Java is updated on your computer.

<http://www.insightassessment.com/>

Login: *(login username)*

Password: *(password)*

Jessica Walter, MEd, ATC
Old Dominion University
Jessicamwalter@gmail.com

APPENDIX D
DEMOGRAPHIC SURVEY

Demographic Questions

Length of post-professional athletic training education program?

- 1 year
- 2 year

Most recent Board of Certification score? _____

Number of times you have taken the Board of Certification exam?

- 1
- 2
- 3
- 4
- 5 or more

Graduate Record Exam (GRE) Verbal Reasoning score _____

Graduate Record Exam (GRE) Quantitative Reasoning score _____

Graduate Record Exam (GRE) Analytical Writing score _____

Undergraduate cumulative grade point average (GPA) _____

Overall, how involved were your undergraduate clinical instructors with your education in athletic training?

- not involved
- minimally involved
- moderately involved
- very involved

Overall, how much did your undergraduate clinical experience contribute to your ability to think critically?

- did NOT contribute
- contributed minimally
- contributed moderately
- significantly contributed

Age _____

Gender

- male
- female
- I choose not to provide this information

Identification

- Black, African American

- White, Caucasian, Anglo American
- Asian, Asian American, Pacific Islander
- Hispanic, Latino, Mexican American
- American Indian/Native American
- Other
- I choose not to provide this information

VITA

Jessica M. Walter

Department of Study

Old Dominion University
Human Movement Sciences
Student Recreation Center
Norfolk, VA 23529

Education

December 2013 Doctor of Philosophy Human Movement Science
Old Dominion University
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May 2007 Master of Science in Education
Old Dominion University
Norfolk, VA

May 2005 Bachelor of Science
Salisbury University
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Publications

Walter JM, Van Lunen BL, Walker SE, Ismaeli ZC, Oñate JA. An assessment of burnout in undergraduate athletic training education program directors. *J Athl Train.* 2009;44(2):190-6.

Hankemeier DA, **Walter JM**, McCarty CW, Newton EJ, Walker SE, Pribesh SL, Jamali BE, Manspeaker SA, Van Lunen BL. Use of evidence-based practice among athletic training educators, clinicians, and students, Part 1: Perceived importance, knowledge, and confidence. *J Athl Train.* 2013;48(3):394-404. Perceived importance, knowledge, and confidence of evidence-based practice concepts in athletic training educators, clinicians, and students. Accepted *J Athl Train.*

McCarty CW, Hankemeier DA, **Walter JM**, Newton EJ, and Van Lunen BL. Use of evidence-based practice among athletic training educators, clinicians and students, Part 2: Attitudes, beliefs, barriers, and accessibility. *J Athl Train.* 2013;48(3):405-414.