Fall 10-26-2016

Exploring the Critical Thinking Skills of Respiratory Care Students and Faculty

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EXPLORING THE CRITICAL THINKING SKILLS OF RESPIRATORY CARE STUDENTS AND FACULTY

BY

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Submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in Health Sciences
Seton Hall University
2016

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Date 10/26/2016

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ACKNOWLEDGMENTS

Praise and honor first and foremost go to God as he has given me all the great things I need to sustain my life, including the ability to complete this dissertation. Thank you God for all I have.

This dissertation would not have been possible without the assistance and guidance of several people. I take this opportunity to extend my sincere thanks and appreciation to all those who have helped me complete this dissertation.

I am highly indebted to Dr. Genevieve Pinto Zipp, my academic advisor and my dissertation committee chair, for her continuous advice, feedback, guidance, encouragement, and support throughout my doctoral studies and particularly in this dissertation. Her incredible patience, timely wisdom, and reassuring presence and commitment have motivated me to move forward, even in difficult times. Thank you; it has been a privilege to work with you.

My gratitude is also extended to Dr. Deborah DeLuca, my dissertation committee member, for her faith, insight, and assistance. I truly appreciate your words of encouragement and support.

I warmly thank Dr. Terrence Cahill for serving as a reader member on my dissertation committee and for reviewing my dissertation chapters.

In addition, I express my appreciation to Dr. Lee Cabell for dedicating his time, believing in me, and reviewing my statistics. I will be forever grateful to you for teaching me statistics courses.

I also would like to thank Ms. Wendiann Sethi for serving as a second coder for my qualitative data and for answering any questions that arose.

Sincere thanks also go to Dr. Arzu Ari for her continuous support and help in the recruitment portion of my study.

In addition, I extend my gratitude to the respiratory care students and faculty who graciously gave their time to complete my survey. Special acknowledgment is due to the directors of accredited respiratory care programs for helping me reach out to my participants. It is literally true that this research could not have been completed without your participation and cooperation.

I am forever grateful to my parents for their endless love, caring, prayers, support, encouragement, and wisdom. I can barely find the words to fully express how much they have influenced and contributed to my life. It was under their watchful eye that I gained so much drive and the ability to tackle challenges head on during my graduate studies journey in the US. Saying thank you is not enough in front of all that you have done for me, but I promise to make you proud of me in every way I can.

Finally, my heartfelt thanks go to my lovely brothers and sisters for their continuous faith, love, support, encouragement, and kindness. I have had the outstanding luck of being surrounded by wonderful brothers and sisters.

DEDICATION

This dissertation is dedicated with gratitude to my beloved parents, Ramadan and Zahrah, and my treasured siblings. Your eternal and endless love, support, motivation, and encouragement throughout my life have enriched my soul and inspired me to chase my dreams to please you and make you proud.

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ABSTRACT

EXPLORING THE CRITICAL THINKING SKILLS OF RESPIRATORY CARE STUDENTS AND FACULTY

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Introduction: Today, with the increased demands in health care, working as a competent respiratory therapist requires being a highly skilled, critically thinking professional. Although students are expected to learn how to think critically mostly in the academic environment from their faculty, only a paucity of studies has assessed the critical thinking of respiratory care students, with none, to our knowledge, assessing that of faculty. Therefore, the purpose of this mixed method study was to (1) assess the overall critical thinking skill levels of both respiratory care students and faculty, (2) investigate whether respiratory care faculty have stronger overall critical thinking skills than respiratory care students, and (3) determine respiratory care student and faculty perceptions regarding what critical thinking is and how it develops.

Methods: All Commission on Accreditation for Respiratory Care accredited U.S. respiratory care education program directors were emailed a request to participate and forward an attached letter of solicitation to their current respiratory care students and faculty. The link to the online survey was embedded in the solicitation letter. The online survey consisted of two sections: (1) profile sheet including demographic and three open-ended questions intended

to collect qualitative data and (2) the Health Sciences Reasoning Test (HSRT) to assess participants' critical thinking skill level.

Results: Twenty-two respiratory care students and 20 respiratory care faculty completed the HSRT. The mean of the overall critical thinking score showed a moderate level for the respiratory care student group (17.81) and a strong level for the respiratory care faculty group (21.65). The independent samples *t*-test revealed that the respiratory care faculty group had statistically significant stronger overall critical thinking scores than the respiratory care student group (p =.007). The qualitative component of the study revealed that in general participants were able to use themes identified in the literature to define critical thinking, report the role that faculty play in promoting students' critical thinking, and list the educational strategies that promote students' critical thinking.

Conclusion: The findings revealed that both the respiratory care students and faculty who participated in this study demonstrated an ability to think critically. The study also supported the assumption that respiratory care faculty have stronger overall critical thinking skills than respiratory care students. In light of these findings, the road to developing strong critical thinking in respiratory care students is partially paved; therefore, it is imperative for respiratory care programs and faculty to work together to take the critical thinking of respiratory care students to the advanced level recommended to meet the competencies specified by 2015 and Beyond.

Chapter I

INTRODUCTION

Background of the Problem

One of the relatively fastest growing professions in allied health care is respiratory care (Adams, 1995; Barnes, Kacmarek, Kageler, Morris, & Durbin, 2011). Respiratory care practice has developed from a narrowly defined scope of practice in which therapists were responsible for delivering oxygen cylinders to patients' bedside to the point where they assume many responsibilities, including assessment, diagnostic evaluation, patient education, treatment administration and development, management, and care for patients with cardiopulmonary dysfunction, ranging from premature infants to elderly people (Shelledy & Wiezalis, 2005).

Respiratory therapists can work in a variety of settings such as hospitals, physician offices, skilled nursing facilities, home care, pulmonary rehabilitation programs, and sleep disorder centers. However, most respiratory therapists work in hospitals, primarily in critical care areas like intensive care units and emergency rooms where they manage ventilators and deliver life-saving approaches to treat and care for critically ill patients (Kacmarek, Stoller, & Heuer, 2016). Regardless of the setting in which the respiratory therapists practice in, their ability to critically think is essential as they seek to provide evidenced-based competent patient care. For example, in order to deliver care to their patients, respiratory therapists often use sophisticated equipment and

technologies such as mechanical ventilators to address complex and life-threatening respiratory problems encountered by patients. As with any highly technical advanced piece of equipment, problem solving skills are required by the operator as they seek to deal with equipment malfunctions and possibly the absence of needed equipment in an emergency. Often, to identify a possible issue with a system or a patient, many pieces of equipment used by respiratory therapists sound an alarm to identify an error which requires immediate attention by the respiratory therapists. Thus, creating the need for efficient critical thinking skills to be employed by the respiratory therapist as any error or delay, even for a few minutes, could result in a patient's condition deteriorating or even the patient's death.

Respiratory therapists must also use critical thinking skills when faced with surprising or unexpected situations like a rare clinical event, an unexpected patient response, complications, or a rare disease (Mishoe, 2003). Respiratory therapists also need critical thinking to prioritize situations when they have to deal with conflicting demands and emergencies (Mishoe, 2003). In a typical day in an intensive care unit, a respiratory therapist may receive a code blue (a hospital code signifying that a patient requires immediate cardiopulmonary resuscitation) while performing a procedure like suctioning on a patient. A few minutes later, a nurse may call the same therapist to come and take an urgent arterial blood gas for another patient. This scenario puts the respiratory therapist in a stressful situation and mandates that the therapist

think quickly and priorities the situational needs. Ultimately, a respiratory therapist must possess the critical thinking skills to ensure that all patients receive safe and optimum care by making appropriate evidenced-based quick judgments while prioritizing medical emergency situations.

Respiratory therapists do not work alone in providing patient-centered care. Respiratory therapists must work as collaborative partners within inter-professional health care teams in order to deliver high-quality patient-centered care (Barnes et al., 2010). As a collaborative partner, the respiratory therapist uses critical thinking skills to determine what, when, and how to communicate patient information to other health care providers (Mishoe, 2003). These skills are also required to participate in the decision-making process during rounds, in emergency situations, and when handling an innovative approach to provide the best patient-centered care (Mishoe, 2003).

Key characteristic of a respiratory therapist is the need to be evidenced-based critical thinkers who practice in an inter-professional health care team to meet the needs of patient-centered care models. In response to this need, respiratory care educational programs have begun to explore different strategies to help promote critical thinking skills in respiratory care students in order to prepare them to practice as safe, competent, and skilled respiratory therapists who can meet the growing demands of health care and provide high-quality patient care. This interest is evidenced by the American Association for Respiratory Care (AARC) taskforce, called 2015 and Beyond.

In late 2007, the AARC established 2015 and Beyond with an overarching goal of defining the expected role of respiratory therapists from 2015 going forward with respect to the growing demands in health care. To reach this goal, the AARC project was conducted through a series of three conferences. In the first conference, AARC acknowledged major changes forthcoming in the national health care system: For example, increased pressure to improve quality of care and reduce cost, shift in the focus of care from acute to chronic, increased aging population, and the presence of innovations and new technologies in health care. Because of these expected changes in the United States health care, the AARC expects substantial evolution in the role and responsibilities of respiratory therapists in the near future. To address this expectation, the second conference's goal was to identify the competencies that respiratory therapists will need to practice in 2015 and beyond (Kacmarek et al., 2009).

In the second conference, the AARC identified critical thinking as an essential skill to master many competencies that respiratory therapists need to practice in 2015 and beyond; these competencies are concentrated in seven major areas: patient assessment, diagnostics, disease management, therapeutics, emergency and critical care, evidence-based medicine and respiratory care protocols, and leadership (Barnes, Gale, Kacmarek, & Kageler, 2010). Accordingly, the AARC has required every respiratory therapist to demonstrate an advanced level of critical thinking and apply the appropriate

best practice protocol (Barnes et al., 2010). The AARC has also called for respiratory care education programs to use educational strategies that promote critical thinking to prepare students for the challenges associated with respiratory therapists' responsibilities and their expanding role, as projected by 2015 and Beyond (Barnes et al., 2010). However, the questions remain: "how do we assess the demonstration of advanced levels of critical thinking in the respiratory care students?", and "how can we ensure that respiratory care faculty members posses good critical thinking skills in order to be able to promote students' critical thinking through incorporating educational strategies in the classroom?"

In addition to the call to promote the further development of critical thinking in respiratory care students, the AARC taskforce recognized that although the role of respiratory therapists has greatly expanded, no changes have been made in the educational requirements of respiratory therapists in the past 40 years (Barnes et al., 2011). The minimum degree and credential required to practice as a respiratory therapist is still the attainment of an associate degree and the successful passing of the entry-level examination, certified respiratory therapist (Barnes et al., 2011). Therefore, at the third AARC conference, the majority of participants reached an agreement to require a baccalaureate degree as the minimum entry practice degree, in addition to passing the advanced-level examination to become a registered respiratory therapist, to ensure that respiratory therapists have the level of knowledge and

critical thinking skills needed to demonstrate competence in the respiratory care scope of practice projected by 2015 and Beyond (Barnes et al., 2011). The recommendation for the minimum educational degree was approved by Commission on Accreditation of Respiratory care (CoARC) on January 28, 2016 and will be required as of 2018 (CoARC, 2016a).

Clearly, critical thinking is central to the function of respiratory therapists, but critical thinking is a complex process that has been defined differently by philosophers and scholars based on their perspectives, beliefs, and purposes in the literature (Boostrum, 1994; Brookfield, 1987; Ennis, 1985; Facione, 1990; Paul, 1992; Watson & Glaser, 1980). For the purpose of this study, a combination of two of Mishoe's (1994, 2003) definitions of critical thinking will be employed; critical thinking is a combination of logical reasoning, problem solving, and reflection needed to demonstrate the seven critical thinking skills required in respiratory care practice: prioritizing, anticipating, troubleshooting, communicating, negotiating, reflecting, and making decision. Mishoe's definitions of critical thinking were selected to guide this study because they constitute the foundational framework in regard to critical thinking in respiratory care practice for many authors (Goodfellow, Valentine, & Holt, 1999; Shelledy, Gardner, & Wettstein, 2004a). Not surprising, the presence of diverse definitions of the concept of critical thinking has lead to creation of numerous measurement tools to evaluate constructs noted in the definition of critical thinking. Watson and Glaser Critical Thinking Appraisal (WGCTA) and

California Critical Thinking Skills Test (CCTST) are the most frequently utilized critical thinking measurement tools in the literature; however, these tools measure general critical thinking. When health sciences researchers have used the CCTST and WGCTA on health care students, inconsistent results have been noted (Hill, 2002; LeGrand & Shelledy, 1999; Shelledy, Gardner, Carpenter, & Murphy, 2004b; Wettstein, Wilkins, Gardner, & Restrepo, 2011). In response to the need to measure critical thinking of health care students and professionals, Facione and Facione (2006) developed the Health Science Reasoning Test (HSRT). The questions posed within the HSRT are framed in health care context, making it a more situationally appropriate tool to measure critical thinking of health care students and professionals than WGCTA and CCTST. Therefore, the HSRT was used to measure critical thinking of study participants within this study.

Need for the Study

The ability to think critically is the main proficiency necessary to function as a respiratory therapist. Thus, critical thinking in respiratory care students must be fostered. To reach this end, the first step is to assess the critical thinking skill level of respiratory care students to understand their strengths and weaknesses and thus make changes accordingly. Unfortunately, the literature presents limited studies that have measured the level of critical thinking skills of respiratory care students. In addition, the few studies conducted have used tools such as WGCTA and CCTST that measure critical thinking generally, thus

they may not translate to the critical thinking skills used within clinical situations by respiratory therapists (Hill, 2002; LeGrand & Shelledy, 1999; Johnson & Van Scoder, 2002; Shelledy et al, 2004a,b; Shelledy, Valley, Murphy, & Carpenter, 1997; Wettstein et al., 2011).

In addition to assessing students' critical thinking, it is also important to assess faculty critical thinking skills as they play an integral part as mentors or facilitators in promoting students' critical thinking skills. Adams (1995) stated, "Respiratory care educators must prepare their students for this expanded role in health care by teaching critical thinking" (p. 31). Furthermore, Robbins (1988) stated that the first step in fostering respiratory care students' critical thinking is to improve faculty critical thinking. Although the literature highlights that respiratory care faculty have a role in promoting critical thinking in their students, the researcher of this current study has been unable to locate any study which has measured respiratory care faculty levels of critical thinking. This lack of assessment leads us to question whether faculty are acting as mentors and role models. Clearly, if we do not know the level of their critical thinking skills, how can we assume that they are good mentors and role models for critical thinking in students who must learn these skills to be effective respiratory therapists?

After assessing the critical thinking skill levels of both respiratory care students and faculty, it is necessary to compare their critical thinking. Although it is reasonable to assume that respiratory care faculty members have stronger

critical thinking skills than their students, no empirical evidence in the literature supports this assumption. Given that one may not effectively promote something unless one has experience with it, exploring this assumption will provide insight into the potential ability of respiratory care faculty to promote critical thinking in their students.

We hope this study can provide the groundwork for understanding critical thinking skill levels of both respiratory care students and faculty members for future studies and arm respiratory care educational programs with information needed to develop an educational environment that seeks to develop and advance students' critical thinking as a means to prepare them to be competent evidenced-based patient-centered respiratory therapists who effectively meet the growing demands in health care.

Purpose of the Study

This study has primary and secondary purposes. The primary purposes are to (1) assess the critical thinking skill level of respiratory care students, (2) assess the critical thinking skill level of respiratory care faculty, and (3) determine whether there is a difference between the critical thinking skills of respiratory care students and faculty. The secondary purpose is to determine respiratory care students' and faculty's perceptions regarding critical thinking and faculty roles in promoting students' critical thinking.

Research Questions

Primary Research Questions

The primary purposes of the study were addressed using a quantitative research approach.

RQ1: What is the overall level of critical thinking skills of respiratory care students, as measured by the Health Science Reasoning Test?

RQ2: What is the overall level of critical thinking skills of respiratory care faculty members, as measured by the Health Science Reasoning Test?

RQ.3: Do the respiratory care faculty members have stronger overall critical thinking skills than respiratory care students as critcal thinking measured by the Health Sciences Reasoning Test?

Secondary Research Questions

The secondary purpose of the study was addressed using a qualitative research approach. Specifically, responses to three open-ended questions were explored to search for themes that further enable the researcher to understand the main research questions.

RQ4. How would you define “critical thinking?”

RQ5. What role do you believe faculty play in fostering students’ critical thinking?

RQ6. What class assignments, activities, and experiences do you believe foster students’ critical thinking? (Please provide specific examples)

Research Hypotheses

Only research question 3 needs a corresponding hypothesis attached to it because it is predictive in scope as it looks for a comparison in critical thinking between respiratory care students and faculty:

H3: Respiratory care faculty members have stronger overall critical thinking skills than respiratory care students as critical thinking measured by the Health Sciences Reasoning Test.

The other research questions do not require a corresponding hypothesis attached to them because they are not predictive in scope (Tully, 2014). The remaining research questions are either descriptive and focus on assessing the overall critical thinking skill levels of both respiratory care students and faculty members (RQ1 and RQ2) or require qualitative data, that is, text-based content to answer the research questions (RQ4, RQ5, and RQ6).

Chapter II

LITERATURE REVIEW

Since critical thinking is imperative for respiratory therapists, this chapter will review the literature on critical thinking in respiratory care to develop an understanding of the concept of critical thinking, how it can be assessed, and how it can be developed. Addressing this foundational information is necessary to further explore the issues surrounding the assessment and development of critical thinking in the context of the respiratory care profession.

Critical Thinking

The concept of critical thinking dates back 2500 years to the ancient Greeks. Indeed, Greek philosopher Socrates established an approach, called the "Socratic method" or "Socratic questioning," that is still used as a critical thinking teaching strategy (Paul, Elder, & Bartell, 1997, as cited by the critical thinking community, n.d.). This approach is based on reflectively questioning common beliefs and assumptions to discover the good beliefs by identifying unreasonable beliefs that lead to contradictions and then discarding them (Paul et al., 1997, as cited by the critical thinking community, n.d.). Socratic questioning is designed to encourage deep thinking on a subject at hand and to demonstrate the importance of evaluating evidence to determine the validity of beliefs (Paul, et al., 1997, as cited by the critical thinking community, n.d.).

Although the concept of critical thinking dates back to the ancient Greeks, it was only at the end of the 20th century that the construct of critical

thinking received considerable attention in the education and health care literature. A review of the literature concerned with critical thinking provides many definitions of it (Boostrum, 1994; Brookfield, 1987; Ennis, 1985; Facione, 1990; Paul, 1992; Watson & Glaser, 1980). For example, Watson and Glaser (1980) stated that:

> Critical thinking is a composite of attitudes, knowledge, and skills. This composite includes: (1) attitudes of inquiry that involve an ability to recognize the existence of problems and an acceptance of the general need for evidence in support of what is asserted to be true; (2) knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence [is] logically determined; and (3) skills in employing and applying the above attitudes and knowledge (p. 1).

Ennis (1985) defined critical thinking as "reasonable, reflective thinking focused on what to believe or do" (p. 45). Paul (1992) stated that critical thinking is "the art of thinking about your thinking while you are thinking in order to make your thinking better, more clear, more accurate, more defensible" (p. 11).

According to the American Philosophical Association (APA), these multiple definitions of critical thinking create a lack of clarity and accuracy which makes it difficult to develop a valid critical thinking assessment tool or effective critical thinking instructional programs (Facione, 1990). Therefore, the APA assigned Facione to conduct a Delphi study to articulate a consensus, clear, and accurate conceptualization of critical thinking (Facione, 1990). After two years of work with 46 experts in critical thinking from different disciplines, they agreed on the following cross-disciplinary conceptual definition of critical thinking: "We understand critical thinking to be purposeful, self-regulating

judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual consideration upon which that judgment is based" (Facione, 1990, p. 2).

Facione's (1990) statement includes the core cognitive skills of critical thinking: interpretation, analysis, evaluation, inference, explanation, and self-regulation. In addition to the cognitive skills, Facione (1990) described the affective dispositions of critical thinking as characteristics of the ideal critical thinker:

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit (Facione, 1990, p. 2).

Facione's (1990) study helped to provide a consensus statement on critical thinking that includes both the skills and the dispositions of critical thinking; however, this definition of critical thinking is cross-disciplinary. Some of the researchers argued that critical thinking is domain-specific. McPeck (1990) suggested that employing discipline-specific knowledge and skills to solve real-life problems can be described as critical thinking. Similarly, Paul (1992) defined critical thinking as "learning to think within one's discipline by appropriating the standards and values embodied in that discipline" (p. 14). Based on the belief that critical thinking is domain-specific, Scheffer and

Rubenfeld (2000) conducted a Delphi study to generate a consensus nursing-specific critical thinking definition. They defined critical thinking in the context of the nursing discipline as:

> Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers exhibit these habits of mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge (p. 357).

According to Raymond-Seniuk and Profetto-McGrath (2011), the definition generated by Scheffer and Rubenfeld (2000) asserts that intuition, contextual perspective, and creativity are components of critical thinking in the nursing profession. However, these concepts were not identified in Facione (1990) cross-disciplinary definition. These various concepts illustrate the differences between the definition of critical thinking in the context of nursing and its definition outside nursing.

Similarly, respiratory care as a discipline needs a clearly defined description addressing the unique aspects of critical thinking in respiratory care. If critical thinking is expected to be fostered through professional and continuing education, the education community must acknowledge what critical thinking is and how it influences a professional because critical thinking might not be achieved in a profession without understanding its meaning in that professional (Mishoe, 2003).

Critical Thinking in Respiratory Care

The term “critical thinking had become an omnipresent buzzword in educational writings” (Mishoe, 1993, p. 31). A review of the respiratory care literature has uncovered several beliefs and interpretations regarding critical thinking in the context of respiratory care. Looking at these beliefs and interpretations may be helpful in understanding the concept of critical thinking in the respiratory care context.

The literature reveals that respiratory care scholars support the notions of Paul (1992) and McPeck (1990) and thus support the notion that critical thinking is domain-specific. Robbins (1988) stated that knowledge is a must and a skill like critical thinking is necessary to apply knowledge in clinical settings. Likewise, Mishoe (2003) found that critical thinkers must have domain-specific knowledge to solve real problems in practice. Respiratory care scholars have also agreed that critical thinking does not develop over a single day; rather, it is a process that develops with practice. Robbins (1988) stated that “the ability for critical thought does not just happen. It must be developed through practice and is dependent upon an individual’s stage of cognitive development” (p. 24). Similarly, Adams (1995) argued that critical thinking is a process and stated, “Critical thinking develops through early education and life experience. It is an ongoing process that evolves as more information is acquired and more knowledge gained” (p. 32).

Respiratory care scholars have also looked to the components of critical

thinking According to them, critical thinking involves skills necessary to make decisions and solve problems. Robbins (1988) stated that “critical thinking is the ability to suspend judgment, to consider alternatives, to analyze, and to evaluate. It includes the skills necessary for self-directed inquiry, hypothesis formation, and testing, and it also requires a healthy skepticism” (p. 24). Adams (1995) defined critical thinking as “the ability to analyze a problem in its totality and then furnish a judgment that leads to an appropriate solution” (p. 31). Similarly, Mishoe and MacIntyre (1997) suggested that critical thinking’s definition in the context of respiratory care must include the ability to solve problems. In addition to problem solving, Mishoe (1994) added the principle of logical reasoning and reflection to her definition of critical thinking. Mishoe (1994) involved these three principles because she found that “various definitions of critical thinking reveal differences in understanding and the viewed importance of these aspects: logical reasoning, problem solving, and reflection” (p. 31). Thus, she defined critical thinking as a combination of logical reasoning, problem solving, and reflection (Mishoe, 1994). Other elements of critical thinking in respiratory care practice that were acknowledged by Mishoe and MacIntyre (1997) and Mishoe (2003) include basic skills such as speaking, writing and reading. Mishoe and MacIntyre (1997) stated that “speaking requires that we articulate our thoughts in such a way that others listening can translate our thoughts into experiences. Listening requires that we analyze the logic of the speaker” (p. 79). Respiratory therapists need these basic skills to

effectively communicate information necessary for patient care to others, including health care providers, patients, and patients' family and caregivers. Mishoe and MacIntyre (1997) said that "critical thinking in respiratory care is not possible unless the practitioner can communicate effectively with others as a primary means for giving and receiving information needed for patient care" (p. 79). This fact is supported by the majority of respiratory therapists who participated in Mishoe's (2003) qualitative study as they considered communication one of the most important skills in their practice.

To elaborate on the concept of critical thinking in the context of respiratory care practice, it is important to shed light on Mishoe's (2003) study since it is considered a foundational framework of critical thinking in the context of respiratory care practice. Mishoe (2003) performed a qualitative study that involved observation of the practice of 18 experienced registered respiratory therapists employed in different types of intensive care units, followed by in-depth interviews to identify and describe critical thinking skills needed in respiratory care practice.

Mishoe (2003) identified and described seven essential critical thinking skills that respiratory therapists need: prioritizing, anticipating, troubleshooting, communicating, decision making, negotiating, and reflecting. These skills can be defined as follows: Prioritizing is the ability to arrange work or to respond in an order of importance in both the expected situation that needs "organized thinking" and the unexpected situation that requires "rapid thinking," such as an

emergency. Anticipating is the ability to take action or respond to something before it happens so that problems can be avoided or solutions can be found earlier. Troubleshooting involves the ability to investigate and solve technical problems related to equipment, such as mechanical ventilators. Communicating means exchanging information needed for patient care between respiratory therapists and others, including physicians, other respiratory therapists and health care providers, patients, and patients' family, in any form of communication: oral, written, or non-verbal. Negotiating skill refers to the ability to discuss medical orders and responsibilities for patient care with the intent to influence others' decisions or actions to obtain a change, so negotiation requires more than just the information exchange involved in communication. Decision making is the ability to reach a judgment or conclusion. The decision can be made on the therapist's own, by sharing with nurses and physicians, and by consulting others with the ultimate goal of facilitating the delivery of safe and effective patient care. Last, reflecting is the ability to think about your thinking so as to explore assumptions, opinions, biases, and decisions. Respiratory therapists reflect on their work, patients, past decisions, and profession to learn from their previous mistakes and problems.

Knowing what skills involve critical thinking leads us to think about what kind of person would be apt to use critical thinking skills. Mishoe (1994) mentioned the personal traits that affect critical thinking in the practice of

respiratory care, which are “willingness to reconsider, willingness to challenge others, appreciation of multiple perspectives and continued learning, understanding of departmental and professional perspectives that impact the profession, and openness to continuing change in personal life and professional life” (p. 183).

In addition to the essential skills and personal traits, Mishoe (1994) found that critical thinking is difficult in respiratory care practice without an interrelationship among organizational factors. The organizational factors that affect critical thinking in respiratory care practice are (1) involvement and level of support from the medical director, (2) departmental administration and climate of the respiratory care department, (3) scope of practice, duties, and responsibilities, and (4) role delineations between registered respiratory therapists and certified respiratory therapy technicians (Mishoe, 1994, p. 204).

Based on Mishoe (1994, 2003), critical thinking in respiratory care practice depends on the previously identified skills and traits that respiratory therapists should possess as well as the aforementioned organizational factors that give respiratory therapists greater opportunities to engage in critical thinking.

After discussing the concept of critical thinking in the context of respiratory care and for the purposes of this study, a combination of two of Mishoe’s (1994, 2003) definitions of critical thinking will be employed to guide this study: Critical thinking is a combination of logical reasoning, problem

solving, and reflection needed to demonstrate the seven critical thinking skills required in respiratory care practice: prioritizing, anticipating, troubleshooting, communicating, negotiating, reflecting, and making decisions. Mishoe's definitions of critical thinking were selected because respiratory care researchers suggest that critical thinking is domain-specific and, thus, it is reasonable to select a definition of critical thinking that is specific to the context of respiratory care. Another reason for selecting Mishoe's definitions is that they are based on a solid scientific foundation; Mishoe (1994) shares common principles found in the definitions of critical thinking in the literature and is suitable for respiratory care practice. Mishoe's (2003) definition is based on a qualitative study involving observations and in-depth interviews of 18 experienced registered respiratory therapists who have worked in different types of intensive care units. Mishoe's (2003) definition is also considered as a foundational framework of critical thinking in the context of respiratory care practice; many respiratory care researchers have used her definitions as a framework to guide and construct their critical thinking instruments (Goodfellow et al., 1999; Shelledy et al., 2004a).

Once we have defined critical thinking, we can begin to measure it, as it is through measuring critical thinking that educators can design learning strategies to promote critical thinking in students.

Measurement of Critical Thinking

The concept of critical thinking given it diverse definitions has sparked

numerous researchers to develop measurement tools to evaluate the constructs noted in their definitions. This section categorizes the critical thinking tools used in the literature into three buckets: (1) critical thinking standardized tests for the general population, (2) critical thinking standardized tests for the health care population, and (3) critical thinking instruments for the respiratory care population.

Critical Thinking Standardized Tests for the General Population

One standardized test that is widely used to measure critical thinking in nursing and allied health care education research is the Watson-Glaser Critical Thinking Appraisal (WGCTA; Daly, 2001; Hill, 2002; LeGrand & Shelledy, 1999; Shelledy et al., 1997, 2004a,b; Vogel, Geelhoed, Grice, & Murphy, 2009; Wettstein et al., 2011). The WGCTA is a self-administered test developed by Goodwin Watson and E. M. Glaser to assess subjects' ability to reason analytically and logically (Watson & Glaser, 2008). They developed the WGCTA based on their definition of critical thinking, which stated that:

> Critical thinking is a composite of attitudes, knowledge, and skills. This composite includes: (1) attitudes of inquiry that involve an ability to recognize the existence of problems and an acceptance of the general need for evidence in support of what is asserted to be true; (2) knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence [is] logically determined; and (3) skills in employing and applying the above attitudes and knowledge (Watson & Glaser, 1980, p. 1).

The WGCTA consists of a set of five tests to assess the subject's ability to (1) make inferences, (2) recognize assumptions, (3) perform deduction, (4)

interpret, and (5) evaluate arguments (Watson & Glaser, 2008). Each test asks the examinee to respond to a number of items based on given scenarios. The content of the scenarios and items deals with neutral or controversial subjects of daily life. Scores from the five tests are combined to generate a total score that represents a reliable measure of the subjects' critical thinking ability. The original version of the WGCTA contains 80 items and is published in two versions, Form A and Form B, and can be completed in 60 minutes. The shorter form comprises 16 scenarios and 40 items and can be completed in 30 minutes in a paper-and-pencil or computer-based format.

The WGCTA short form is a reliable and valid tool. Its internal consistency based on Cronbach's alpha for reliability ranged from .76 to .85 (Watson & Glaser, 2008). Additionally, its test-retest reliability was .89 for the total score of its five subscale scores when the test was conducted in a sample of 57 participants who took the test two times with an interval of 4 to 26 days (Watson & Glaser, 2008). The Watson and Glaser definition of critical thinking mentioned earlier serves as the content validity of the WGCTA (Watson & Glaser, 2008). Other types of validity such as criterion, convergent, and discriminant validity were also established for the WGCTA (Watson & Glaser, 2008).

The WGCTA has been used in several studies reported in the respiratory care literature to explore the relationship between critical thinking and decision making (Hill, 2002; LeGrand & Shelledy, 1999; Shelledy et al.,

1997, 2004a,b; Wettstein et al., 2011). However, the results of these studies have been inconsistent: The findings have demonstrated either a relatively weak but statistically significant or no relationship between critical thinking ability measured by the WGCTA and decision-making performance on clinical simulation examinations. The clinical simulation exam is a part of the registered respiratory therapist credential examination (Smith, 2001) and consists of 10 clinical problems to test the examinee mainly in two components: information gathering and decision making (Smith, 1997). According to Shelledy, Gardner, Carpenter, and Murphy (2004b), the inconsistent findings regarding the relationship between the critical thinking and decision making components of the clinical simulation exam support the fact that the construct measured by the WGCTA is different from that assessed by the decision making section of the clinical simulation exam. Furthermore, Wettstein, Wilkins, Gardner, and Restrepo (2011) suggested that the absent or weak relationship between the WGCTA and clinical simulation exam shows that the WGCTA is an appropriate tool for measuring the critical thinking of the general population, but not necessarily the critical thinking ability of health care students or, specifically, respiratory care students. Another limitation of the WGCTA is its inability to detect changes in critical thinking with additional professional education (Bauwens, 1987; Slaughter, Brown, Gardner, & Perritt,1989).

Other widely used standardized tests for measuring critical thinking found in the nursing and allied health literature are the California Critical

Thinking Skills Test (CCTST) and California Critical Thinking Disposition Inventory (CCTDI). The CCTST is a 34-item tool in a multiple-choice question format set in everyday scenarios which measures the skills of critical thinking in five subscales: analysis, evaluation, deduction, induction, and inference (as cited in Behar-Horenstein & Niu, 2011), whereas the CCTDI is a 75-item tool using a 6-point Likert scale ranging from strongly agree to strongly disagree that assess seven affective (traits) dimensions of critical thinking: truth seeking, open mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity (Giancarlo & Facione, 2001). The content validity of the CCTST was based on the definition of critical thinking developed by the APA Delphi study (Facione & Facione, 1994), which stated, "We understand critical thinking to be purposeful, self-regulating judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual consideration upon which that judgment is based" (Facione, 1990, p. 2). Similarly, the items of the CCTDI were theoretically derived from the APA Delphi study's description of the ideal critical thinker (Giancarlo & Facione, 2001):

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit (Facione, 1990, p. 2).

Furthermore, both tools demonstrate good reliability: The CCTDI

internal consistency reliability for the seven subscales had a Cronbach's alpha ranging from .71 to .80 (Facione, Facione, & Giancarlo, 2001) and the Kuder Richardson (KR) Formula 20 internal consistency coefficient for the CCTST ranged from .68 to .69 (Facione & Facione, 1994).

The CCTST and CCTDI have been used throughout the nursing and allied health care literature (Blondy, 2011; Bartlett & Cox, 2002; Cisneros, 2009; Foluso & Cesarina, 2014; Wessel & Williams, 2004; Zygmont & Schaefer, 2006). However, they have been used only once in the respiratory care literature to determine whether students' critical thinking skills or dispositions toward critical thinking can predict their performance on written registry self-assessment examinations (Johnson & Van Scoder, 2002). In Johnson and Van Scoder's (2002) study, 17 senior students in a baccalaureate respiratory therapy program were enrolled and completed both the CCTST and CCTDI to measure their critical thinking skills and their dispositions toward critical thinking, respectively. The students took the self-assessment examination of the written registry test four months after they completed both the CCTST and the CCTDI. Johnson and Van Scoder (2002) found a weak and non-significant correlation between the total scores for the CCTST and the written registry test and between the CCTDI and the written registry test. Johnson and Van Scoder (2002) concluded that the CCTDI, CCTST, and each of the individual subscores are not valid predictors of student performance on the written registry test.

In conclusion, although the WGCTA and CCTST are the most common tools utilized in the literature, studies have revealed inconsistent results when applying them to health care populations, including respiratory care (Johnson & Van Scoder, 2002; Hill, 2002; Wettstein et al., 2011). This inconsistency may be because the questions on these tools rely on neutral topics of daily life and do not apply specifically to the health care context. Therefore, studies have suggested that the WGCTA and CCTST are appropriate tools for measuring critical thinking for the general population, but not necessarily for health care students and professionals (Shelledy et al, 2004b; Wettstein et al., 2011). Thus, after reviewing these assessment tools, caution in their use among health science professionals is warranted.

Critical Thinking Standardized Test for Health Care Population

In response to the need for a critical thinking measurement tool specific to health care professions, Facione and Facione (2006) developed a tool called the Health Sciences Reasoning Test (HSRT). The HSRT, evolved from the CCTST, is a standardized tool specifically designed to assess critical thinking skills for health care students (undergraduate and graduate) and health care professionals (Insight Assessment, 2016). The HSRT consists of 33 multiple-choice questions set in a short health care context. However, it does not require health care knowledge because the specialized information needed to answer questions is provided in the question stem itself in either a text-based or diagrammatic format (Insight Assessment, 2016). The HSRT questions are

designed to require the examinee to “draw inferences, make interpretations, analyze information, draw warranted inferences, identify claims and reasons, and evaluate the quality of arguments” (Insight Assessment, n.d., para. 4). The HSRT reports five subscale scores (inference, analysis, evaluation, induction, and deduction) and an overall score, representing the total number of correct answers out of 33 questions. From the reported six scores of the HSRT, the overall score is the most important and reliable one as it comprehensively measures the critical thinking skills of an individual (Insight Assessment, 2016). The HSRT takes about 50 minutes to administer and is available in paper and online versions (Insight Assessment, 2016).

The HSRT has good reliability for the overall and the five subscale scores. It has a KR Formula 20 internal consistency coefficient of .81 for the overall score, which exceeds the minimum threshold of strong KR-20 internal consistency (.70) for instruments with multidimensional scales (Insight Assessment, 2016). The KR-20 for the subscales ranges from .52 to .77: inference (.52), analysis (.54), deduction (.71), induction (.76), and evaluation (.77) (Huhn, Black, Jensen, & Deutsch, 2011).

The content validity of the HSRT is based on the consensus definition of critical thinking identified in the APA Delphi study (Facione, 1990). The construct validity of the HSRT has been established by assessing its ability to distinguish the critical thinking skills between expert and novice physical therapists (Huhn et al., 2011). Ninety-seven first-year doctor of physical therapy

students from two physical education programs and 73 expert physical therapists completed the HSRT. Huhn, Black, Jensen, and Deutsch (2011) found that the HSRT was able to detect differences between experts and novices' overall score ($t_{(148)}$ = 2.67, p = .008), analysis subscale score ($F_{(1.150)}$ =12.94, p = < .001), and deduction subscale score ($F_{(1.150)}$ = 5.96, p = .01). Additionally, the HSRT has also detected changes in critical thinking scores of physical therapy students during their education. Huhn, Black, Jensen, and Deutsch (2013) recruited 63 students from two physical therapy education programs to track their critical thinking changes during their education. All physical therapy students completed the HSRT three times: The first time was upon entry to the program, the second time was before final affiliations, and the third time was before the graduation. Huhn et al. (2013) found a statistically significant change for the total score and for both the deductive and analysis subscale scores of critical thinking between the first and the second point in time; a significant difference between the two physical therapy programs was found in the initial test scores when adjusting for variance. Huhn et al. (2013) concluded that the HSRT could detect changes in critical thinking scores over time.

Based on the above discussion, the HSRT has good content and construct validity and reliability. On the other hand, one limitation of the HSRT is that it does not test domain-specific knowledge. In respiratory care, problem solving and critical thinking are highly specialized since they need a

sophisticated knowledge base to identify, analyze, and solve clinical problems (Shelledy et al., 2004b). Thus, the HSRT may not be specifically relevant to the particular abilities needed in the clinical practice of respiratory therapists. Therefore, instruments designed specifically to measure actual critical thinking in the respiratory care context are needed.

Critical Thinking Instruments for Respiratory Care Population

In health care professions, generally, few domain-specific assessments of critical thinking are available. Within the respiratory care profession, the experts in philosophy and social sciences have considered the clinical simulation examination of the National Board of Respiratory Care (NBRC) one of these few domain-specific instruments (Facione, 1990; Mishoe, Dennison, & Goodfellow, 1997).

The NBRC clinical simulation exam is one of the two parts of the registered respiratory therapist credential examination (Smith, 2001); the other part of this credential examination is called the written registry examination and is composed of multiple-choice questions. The NBRC clinical simulation exam produces two scores: information gathering and decision making (Smith, 1997). These two scores are based on a series of 10 clinical problems which the examinee must solve by gathering information based on the clinical problem, interpreting the patient's results data, and making decisions to manage the patient's problem (Smith, 2001). The self-assessment examination of the NBRC clinical simulation exam is available with the same content as the actual

clinical simulation exam and is designed as a practice tool for self-evaluation or student assessment (Cullen, Van Scoder, Podgorski, & Elmerick, 2003).

The NBRC clinical simulation exam is widely thought to measure the critical thinking and problem solving ability of respiratory therapists (Facione, 1990; Goodfellow et al., 1999; Mishoe, 1993). Although the NBRC clinical simulation exam is reported to have content validity, criterion-related validity, and reliability (Shaw, 2002; Smith, 1997, 2001), Cullen, Van Scoder, Podgorski, and Elmerick (2003) questioned the reliability and validity of the self-assessment examination of the NBRC clinical simulation exam. From a convenience sample of advanced-level respiratory therapy students enrolled in respiratory therapy education programs located in four states (Georgia, California, Ohio, and Indiana), 58 students completed the self-assessment of the written registry exam and 56 of them completed the self-assessment examination of clinical simulation exam during their final semester. In this study, the calculated reliability coefficient of the self-assessment examination of the clinical simulation exam for its combined two scores (information gathering and decision making) was .76. This value (.76) was lower than the reliability coefficient of the self-assessment examination of the registry exam (.79) when it was supposed to be higher as the clinical simulation exam is designed to measure the critical thinking ability of the test-taker (Cullen et al., 2003). Additionally, the reliability coefficient of the self-assessment examination of the clinical simulation exam was much lower with the Cronbach's alpha computed

separately for each individual section of this exam: The Cronbach's alpha was .72 and .64 for information gathering and decision making, respectively. As cited in Cullen et al. (2003), the aforementioned reliabilities are considered moderate compared to the suggested alpha coefficient for performance-based testing that ranges between .80/.85 and 1.00. Additionally, a strong correlation existed between the two parts of the registered respiratory therapist examination after attenuation for reliability (self-assessment examination of the clinical simulation exam and the self-assessment of the written registry exam). The reliability between them was .86, which suggests that the two parts of the examination mainly test the same content when they should examine different constructs. Therefore, Cullen et al. (2003) questioned whether the clinical simulation exam adds to the reliability or validity in the testing of respiratory therapists.

The other limitations of the NBRC clinical simulation exam are that it is expensive to administer, time consuming, and tends to test students' knowledge on one clinical problem or case at a time (Shelledy et al., 2004b). This fact is supported by the literature as the published studies have used the self-assessment of the NBRC clinical simulation exam instead of the actual NBRC clinical simulation exam with the exception of Wettstein et al. (2011) (Shelledy et al., 1997, 2004a,b).

Due to the disadvantages of the NBRC clinical simulation exam, including its questioned reliability and validity, respiratory care educators

recognized the need to construct reliable and valid instruments to assess critical thinking specific to the respiratory care population. Goodfellow, Valentine, and Holt (1999) acknowledged this need and developed a self-assessment instrument to measure the perceived critical thinking of respiratory therapists. The theoretical framework of the Goodfellow et al. (1999) instrument is based on Mishoe's (1995) study, which identified seven essential critical thinking skills needed by respiratory therapists (prioritizing, anticipating, troubleshooting, communicating, negotiating, decision making, and reflecting). These seven critical thinking skills served as the constructs of the Goodfellow et al.'s (1999) instrument. This instrument is composed of 44 items and uses a 6-point Likert scale ranging from not well to essentially well. However, the instrument underwent many steps during its construction until it reached its final version of 44 items.

The Goodfellow et al.'s (1999) instrument originally contained 215 items that were generated from an in-depth interview with Mishoe, a review of the literature including Mishoe's (1995) dissertation study, and an expert panel of respiratory therapists. After reviewing the instrument for redundancies, 165 items were left. The content validity of the instrument was then investigated by a panel of expert respiratory therapists, which resulted in reducing the items to 70. The construct validity was then examined by using a modified Q sort procedure, resulting in further reduction in the item pool to 48 questions. However, 10 items were added because two of the seven constructs had too

few items. Thus, the Q sort procedure was repeated and resulted in enough items per construct, and the final item pool was established as 44 questions. The final version with 44 items of the Goodfellow et al.'s (1999) instrument was piloted by mailing the instrument to 100 random registered respiratory therapists who worked in different clinical settings throughout the United States; 60 surveys were returned. To assess the validity of the instrument, several computations were used: Response variance was analyzed and resulted in enough variance for all items, while the intercorrelations revealed possible redundancies in questions. Five sets of questions were reviewed and two were re-worded to eliminate any possible complications. Based on the pilot study, the internal consistency reliability of the instrument yielded a Cronbach's alpha of .94, which is considered strong since it is above the recommended value of 0.7.

According to Goodfellow et al. (1999), the disadvantages of this instrument include untested discriminant validity of the instrument, the subjectivity in assessing the critical thinking behaviors by respondents, and inability to control how respondents measure and interpret the questions. However, Goodfellow et al. (1999) suggested that her instrument is appropriate tool to self-assess critical thinking behaviors of respiratory therapists after minor revisions.

Shelledy, Gardner, and Wettstein (2004a) argued that the Goodfellow et al.'s (1999) instrument of critical thinking was useful for research purposes and

for self-assessment by respiratory therapists but questioned its appropriateness to evaluate student performance. To that end, Shelledy et al. (2004b) constructed and piloted an instrument to be used by respiratory care faculty to assess students' performance in critical thinking and problem solving (CTPS) abilities with respect to respiratory care practice.

Shelledy et al.'s (2004a) instrument consists of 21 items and was created based on the seven critical thinking skills identified by Mishoe (2003) and the basic steps used in solving clinical problems (identify problems, collect information, interpret data, formulate solutions, make decisions, and reevaluate based on patients' response or new information). The CTPS instrument uses a 7-point Likert scale with 7 = agree very much and 1 = disagree very much. The CTPS instrument scores ranged from 21 (low) to 147 (high). The content validity of the CTPS instrument was examined by a panel of experts composed of registered respiratory therapists holding faculty appointments in two respiratory care educational programs. After the CTPS instrument was revised based on panel recommendations, it was piloted; two faculty members used the instrument to independently evaluate 20 senior undergraduate respiratory therapy students enrolled in one program. Students were also asked to complete the WGCTA and solve four clinical problems on the self-assessment examination of the NBRC clinical simulation exam that contained questions about information gathering and decision making. The two faculty who worked with the students in the clinic and academic settings during their junior and

senior years were blinded to the students' scores on the WGCTA and the self-assessment of the clinical simulation exam. The pilot study established the concurrent validity of the CTPS instrument by finding a significant correlation between the instrument and WGCTA (r = .54, p = .02) and between the instrument and the score of both the information gathering and decision making component of the self-assessment version of the clinical simulation exam (r = .51, p = .03; r = .47, p = .04, respectively). Significant correlations were also found between WGCTA and both information gathering (r = .49, p = .04) and decision making (r = .74, p = .0003). The internal consistency of the instrument was very good, based on the Cronbach's alpha (r = .95 for faculty rater one, and r =.99 for faculty rater two). The interrater reliability was satisfactory (r = .66, p = 002). However, the pilot study used to validate the CTPS instrument had limitations due to small sample size, only two faculties being used to measure reliability, subjectivity of faculty in rating students' performance, and the study using only four clinical problems of the self-assessment NBRC clinical simulation exam and not the actual NBRC clinical simulation exam (Shelledy et al., 2004a).

In summary, three instruments designed specifically to measure critical thinking of respiratory care population: the NBRC clinical simulation examination, Goodfellow et al.'s (1999) tool, and Shelledy et al.'s (2004a) tool. However, both the reliability and validity of the NBRC clinical simulation examination have been questioned (Cullen et al., 2003). Goodfellow et al.'s

(1999) tool is designed to measure the perceived critical thinking skills of respiratory care therapists. Shelledy et al.'s (2004a) tool is created for faculty to evaluate student performance in critical thinking and problem solving. Thus, there is still a need to construct an accurate and reliable self-administered instrument to measure the actual critical thinking of the respiratory care population (students, faculty, and therapists). This instrument will help to assess the exact level of critical thinking of respiratory care students/therapists/faculty and will allow for tracking changes in their critical thinking over years of education or experience and after applying different educational strategies or training programs designed to improve critical thinking. Until a self-administered instrument that measures the actual critical thinking specific to the respiratory care population is developed, the HSRT can be used since it is a reliable and valid tool designed to measure the critical thinking of health care students and professionals; this characteristic distinguishes it from other tools that measure general critical thinking such as WGCTA and CCTST and makes it the most appropriate tool to measure the actual critical thinking of respiratory care students and professionals at the current time.

Respiratory Care Students and Critical Thinking

Respiratory care researchers have used the critical thinking measurement tools to assess the level of critical thinking for respiratory care students and respiratory therapists as well as to investigate the factors that

correlate with their critical thinking. For example, Wettstein et al. (2011) designed a study to measure the critical thinking ability of respiratory care students and to determine whether critical thinking correlates with age, educational background, or student performance on the clinical simulation components of the NBRC examination. Fifty-five senior respiratory care students from a baccalaureate respiratory care program in the southwestern United States completed the short form of WGCTA to measure their critical thinking. The study found that in each of the five subsets of WGCTA (evaluation of arguments, deduction, recognition of assumptions, inference, and interpretation), respiratory care students were able to answer at least 50% of the items correctly. They scored high in the evaluation of arguments (73%), deduction (61%), and recognition of assumptions (59%) subsets and low in the inference (51%) and interpretation (50%) subsets. The mean overall critical thinking score, which represents the sum of the five subset scores of WGCTA and is considered the most reliable score among them, was 23.7 ± 5.02 out of a maximum score of 40. Moreover, Wettstein et al. (2011) found no significant relationship between the age of senior respiratory care students (range between 21 and 41 years) and their critical thinking scores (p = .66), which contrasts with Hill (2002), who found a significant correlation between age and critical thinking as measured by WGCTA in a sample of 143 respiratory care students recruited from 10 programs. Wettstein et al. (2011) also found no significant relationship between critical thinking score and student performance

on the clinical simulation components (p = .61 between critical thinking and information gathering and p = .56 between critical thinking and decision making). However, a significant positive association existed between a strong science course background and critical thinking score (p = .04). A strong science course background was defined as completion of 10 credits or more in prerequisite science courses that are required to obtain a bachelor's degree in respiratory care in Texas: biology, chemistry, biochemistry, anatomy, physiology, physics, and/or microbiology. Although the study presents interesting findings, its generalizability is limited since it has a small sample size consisting of 55 senior respiratory care students who were enrolled in only one baccalaureate program.

In another study, Shelledy et al. (2004b) studied whether respiratory course grade point average (GPA) and clinical GPA correlate with the critical thinking measured by WGCTA in 36 first-year students from two area schools (bachelor and associate degree in respiratory care). The study found a moderate significant positive correlation between critical thinking and respiratory GPA (r = .47, p = .004) and clinical GPA (r = .35, p = .03). The findings of this study and Wettstein et al. (2011) indicates that a strong science course background, respiratory course GPA, and clinical GPA are related to the critical thinking of respiratory care students.

Another relationship examined in the literature is between critical thinking and the self-assessment examination of the certified respiratory

therapist examination. Both Shelledy et al. (2004b) and LeGrand and Shelledy (1999) found a significant correlation between respiratory care students' critical thinking, as measured by the WGCTA, and the self-assessment of the certified respiratory therapist examination scores (r = .51, r^2 = .26, p = .001 and r = .43, r^2 = .19, p < .05, respectively). However, the AARC White Paper on RRT Credential (2003) stated that the certified respiratory therapist (entry-level) examination does not test the critical thinking abilities of the test-taker; rather, it tests the test-taker's technical abilities. Therefore, AARC has encouraged all respiratory therapists to obtain the registered respiratory therapist (advanced) credential since it is the only credential that documents that they possess critical thinking, problem solving, and advanced assessment skills.

In contrast to the consistent findings noted regarding the relationship between critical thinking and the self-assessment examination of the certified respiratory therapist test, the relationship between critical thinking and the clinical simulation exam components of the registered respiratory therapist examination, created to measure the critical thinking abilities of the test-taker, is mired in conflict. Although both Shelledy et al. (2004b) and Shelledy, Valley, Murphy, and Carpenter (1997) found a moderate significant positive correlation between critical thinking as measured by the WGCTA and the information gathering section of the clinical simulation exam (r = .54, p = .001; r = .55, p = .006, respectively), Wettstein et al. (2011) did not (p = .61). Similarly, both Shelledy et al. (1997) and Hill (2002) found a weak significant correlation

between critical thinking ability as measured by the WGCTA and decision making section of the clinical simulation exam (r = .49, p = .015; r = .32, p <.01, respectively), but Wettstein et al. (2011) and Shelledy et al. (2004b) did not (r = 0.11; p = 0.54 and p = .56, respectively) .These inconsistent findings may be related to Wettstein et al.'s (2011) use of the actual clinical simulation examination that consists of 10 clinical problems, whereas other studies have used either the self-assessment clinical simulation examination or only one sample of a clinical simulation problem. Shelledy et al. (2004b) and Wettstein et al. (2011) also stated that the WGCTA may not be the appropriate to measure respiratory care students' critical thinking since it only measures general critical thinking and not domain-specific critical thinking that requires a knowledge base to answer the questions on the clinical simulation exam.

Since the WGCTA measures general critical thinking and questions about its ability to measure respiratory care students' critical thinking have been raised (Shelledy et al., 2004b; Wettstein et al., 2011), Colletti (2011) administered the HSRT, a more appropriate tool designed to measure critical thinking specifically for health care professions, to 51 novice respiratory care students, recruited from four accredited respiratory care programs that offer associate degrees, to study the impact of an authentic task on critical thinking; 24 students from two programs were in the treatment group and completed the authentic task of creating a logic clinical simulation along with traditional learning tasks during the academic quarter and 27 students from the other two

programs were in the control group and completed only traditional learning tasks. The critical thinking measurement tool, the HSRT, was administered two times, before completing the authentic tasks, which was at the beginning of the academic quarter, and after completing the authentic tasks, which was at the end of the academic quarter. Since pretest critical thinking scores are considered the baseline and this section is concerned with the assessment of critical thinking of respiratory care students, only pretest scores will be presented here. The study found that the mean of the overall critical thinking score was in the moderate range for both the treatment and control groups (M = 18.1 ± 3.9 and M = 17.1 ± 4.7, respectively). In terms of the HSRT subscale scores, the mean of each was reported as the following: induction: 6.6 ± 1.50 for treatment group and 6.9 ± 1.82 for control group; deduction: 5.0 ± 2.37 for treatment group and 4.5 ± 2.19 for control group; analysis: 3.9 ± 1.03 for treatment group and 3.3 ± 1.38 for control group; inference: 3.1 ± 0.78 for treatment group and 2.7 ± 1.27 for control group, and evaluation: 3.9 ± 1.35 for treatment group and 4.4 ± 1.39 for control group. However, the results of the study cannot be generalized due to the small convenience sample; 51 students from only four associate degree educational respiratory care programs participated in the study, with 24 in the treatment group and the other 27 were in the control group.

Clark (2012) also administered the HSRT to measure the critical thinking of 46 senior respiratory care students from four programs in Southeastern

Pennsylvania to compare the critical thinking between the students who will graduate from baccalaureate degree programs and those who will graduate from associate degree programs. The study found that the mean of the overall score of critical thinking was in the not-manifested range for the associate degree student group, which consisted of 23 students (13.09 ± 4.07) but in the moderate range for the baccalaureate degree student group of 23 students (17.52 ± 6.14). Using an analysis of variance, a significant difference in the HSRT overall score was found between the baccalaureate degree and associate degree groups, keeping in mind that no scores were in the "strong" or "superior" range of the HSRT total scores for the associate degree group and no scores were in the "superior" range in the HSRT total scores for the baccalaureate degree group ($F_{(1, 45)}$ = 8.34, p =.01). In terms of the HSRT subscale scores, the mean of each was reported as the following: induction: 5.00 ± 1.71 for associate degree student group and 6.30 ± 2.60 for baccalaureate degree student group; deduction: 3.30 ± 1.96 for associate degree student group and 4.65 ± 2.48 for baccalaureate degree student group; analysis: 2.74 ± 1.66 for associate degree student group and 3.26 ± 1.57 for baccalaureate degree student group; inference: 1.91 ± 1.08 for associate degree student group and 2.57 ± 1.24 for baccalaureate degree student group; and evaluation: 3.00 ± 1.28 for associate degree student group and 4.00 ± 1.65 for baccalaureate degree student group. A significant difference was found only in evaluation, and deductive reasoning subscale scores between the associate

degree and the baccalaureate degree student groups ($F_{(1, 45)}$ = 5.27, p = .03 and $F_{(1,45)}$ = 4.18, p =. 047, respectively).

Although Clark's findings (2012) are interesting, the generalizability and validity of the findings is limited. The study had a small sample size (23 baccalaureate degree students and 23 associate degree students) with participants recruited from only four respiratory care programs in Southeastern Pennsylvania. Furthermore, the study was timed at 50 minutes and seven students from the associate degree programs had their test interrupted: Five students were interrupted because the instructor, who did not know that the test was timed, talked with them about a summer clinical course. The other two students were interrupted because someone tripped over the power cord and shut down their computers. Interruption in the test and having a final exam directly before taking the HSRT for some students may have resulted in a very low score on the HSRT among both associate and baccalaureate degree students. These very low scores have a strong effect on the sample means and the average percentile ranking for both groups, especially since the sample size of the study was small (Clark, 2012).

In addition to measuring the level of critical thinking in respiratory care students, Goodfellow (2001) assessed the critical thinking behaviors of respiratory therapists through a self-report she created. The self-report is based on Mishoe's (1995) work and thus is composed of seven critical thinking skills (prioritizing, anticipating, troubleshooting, communicating, negotiating,

reflecting, and decision making). The survey was completed by 975 respiratory therapists. The study found that the mean scores for all seven categories of critical thinking skills were relatively high (M = 4.38 to M = 4.84). Specifically, respiratory therapists rated themselves high in the categories of prioritizing, troubleshooting, and communicating, middle in the reflecting and decision making, and low in anticipating and negotiating. Furthermore, the study found that age and educational level of respiratory therapists did not correlate to any critical thinking constructs. However, years of experience and gender correlated significantly with some critical thinking constructs, but with a weak relationship: years of experience and troubleshooting (r = .18, p = .000), years of experience and decision making (r = .12, p = .000), years of experience and anticipating (r = .16, p = .000), and troubleshooting and gender (t = 4.21, p = .000). On the other hand, Goodfellow (2001) is limited by using a self-report and thus the accuracy of information cannot be guaranteed and only represents the opinion of respiratory therapists about their work. Goodfellow (2001) recommended that future studies observe the work of respiratory therapists to confirm the findings of the study. Researchers should also conduct longitudinal studies to track changes in the critical thinking of respiratory therapists and to see whether years of experience really correlate with critical thinking skills when using a large sample size.

In summary, based on the mentioned studies, the level of respiratory care students' critical thinking has been assessed mostly by the WGCTA.

However, the WGCTA, as mentioned previously, measures general critical thinking and thus using this tool may not reflect the exact level of critical thinking needed by respiratory care students. Although Colletti (2011) and Clark (2012) examined the level of respiratory care students' critical thinking by using the HSRT, a more appropriate tool than the WGCTA, these studies had limitations that affected the generalizability and/or validity of their findings. Therefore, there is still a need to assess respiratory care students' critical thinking to determine if they are sufficiently prepared to be competent respiratory therapists who deliver safe and effective patient care. In addition, no study has used qualitative data to understand the perceptions of respiratory care students regarding critical thinking and how it can be developed. Addressing this lack will provide insight regarding the preparation of respiratory care students to learn critical thinking since one cannot learn something without a clear understanding of what it is and how it can be developed.

Respiratory Care Faculty and Critical Thinking

Promoting students' critical thinking skills has become an expectation of faculty (Loving & Wilson, 2000; Wangensteen, Johansson, Björkström, & Nordström, 2010). Adams (1995) stated, "Respiratory care educators must prepare their students for this expanded role in health care by teaching critical thinking" (p. 31). Therefore, it is important to gain an understanding of the respiratory care faculty perceptions and beliefs regarding their role in promoting

students' critical thinking since their beliefs may influence the strategies presented in the classroom to develop critical thinking in students.

In a single qualitative case study, Hulse (2009) focused on the beliefs and practices of nine experts, full-time respiratory care faculty in a strong respiratory care baccalaureate program regarding the teaching of critical thinking. Although Hulse (2009) found no agreement on how respiratory care faculty described critical thinking, they did agree that students' critical thinking can be developed by motivation. The general consensus was that faculty passion is the first and most important student motivator since faculty cannot motivate students if they lack passion and enthusiasm themselves. Other strategies that motivate students include having competent faculty with well-planned curricula who connect clinical experiences to classroom instruction. Respiratory care faculty also believe that the best educational strategies and techniques are those that involve students to learn by doing and necessitate their full participation, including applying knowledge, solving problems together, classroom discourse, peer teaching, peer evaluation, answering critical questions, problem-based learning, evidenced-based practice and a whole-body approach, and reflection (Hulse, 2009).

Other strategies respiratory care programs use to foster critical thinking are clinical simulation, case studies, and role modeling by teachers (Hill, 2002). Robbins (1988) also suggested techniques that respiratory care faculty can use to model critical thinking to their students. These strategies include thinking

aloud (verbalization of thought process), visualization (drawing a visual image of the thought process), breaking down (breaking down a complex problem into small pieces, which helps in solving it), and serial questioning (asking a student a series of questions to guide his/her thought process until reaching a correct answer) (Robbins,1988).

Employing active learning strategies requires faculty to demonstrate critical thinking themselves. Robbins (1988) stated that the first step to start fostering respiratory care students' critical thinking is to improve faculty's critical thinking. Faculty are always assumed to have good critical thinking skills since they have more education and experience and, thus, they are expected to develop students' critical thinking. However, the assumption that respiratory care faculty have good critical thinking skills cannot be guaranteed since, to our knowledge, no studies have measured the level of respiratory care faculty critical thinking. This lack of assessment leads us to question whether faculty are acting as mentors and role models. Clearly, if we do not know the level of their critical thinking skills, how can we assume that they are good mentors and role models for critical thinking in students who must learn these skills to be effective respiratory therapists?

Similarly, as cited in Blondy (2011), the nursing literature has questioned the expectation that nursing faculty have good critical thinking for several reasons. One of the uncertainty expressed by many of them about their own critical thinking skills (Cise, Wilson, & Thie, 2004; Mangena & Chabeli, 2005;

Shell, 2001). Another reason is that some of the nurse faculty reveal that they need education on how to teach critical thinking skills since they have received no or very little formal training for them on this subject (Loving & Wilson, 2000; Mangena & Chabeli, 2005; Naughton & Strobel, 1996). Moreover, resistance of nurse faculty to teaching critical thinking was also a reason to question the assumption that nurse faculty demonstrate good critical thinking (Loving & Wilson, 2000; O'Sullivan, Blevins-Stephens, Smith, & Vaughan-Wrobel, 1997; Shell, 2001).

To test the expectation that nursing faculty have good critical thinking, Blondy (2011) measured the level of critical thinking of the nursing faculty at Midwestern University using the CCTST. Blondy supported the expectation that nursing faculty demonstrate good critical thinking; the mean overall score of nursing faculty on the CCTST was 22.12 (*SD*= 3.64) taken in an untimed format, and this was higher than the generic undergraduate student aggregate norm reference data provided by the Insight Assessment (16.04) in a timed format. In contrast, Zygmont and Schaefer (2006) found variation in the critical thinking of nursing faculty using the CCTST. While the means overall score of faculty's critical thinking was higher than for senior undergraduate students, it was similar to graduate nursing students. Zygmont and Schaefer (2006) interpreted this variation to offer possible conclusions: (1) Critical thinking is a process that develops over time, experience, and education and it starts in undergraduate education, (2) a relationship may exist between the ability of

nurse faculty to engage in critical thinking and the ability of the learner to learn critical thinking skills, and (3) the mean CCTST score of graduate nursing students and its similarity to the mean CCTST score of nurse faculty can be explained by identifying graduate nursing students as a self-selected group.

By analogy, future studies should measure the critical thinking level of respiratory care faculty to provide insightful information to faculty about their level of critical thinking skills, which can aide them as they seek to promote critical thinking in respiratory care students. In addition, no study, with the exception of Hulse (2009), has used qualitative data to understand the perceptions of respiratory care faculty regarding critical thinking and how it can be developed. Hulse's (2009) case study explored the perceptions of expert respiratory care faculty from only one institution, making it difficult to generalize the results. Addressing this lack will provide further insight regarding the preparation of respiratory care faculty as they seek to promote critical thinking in respiratory care students.

Conceptual Framework

The conceptual framework of this study is demonstrated by linking three concepts: critical thinking, role modeling, and mentoring (Figure 1).

Critical thinking is the main phenomenon that this study seeks to describe and explore and thus it is the fundamental basis of this study's conceptual framework. Critical thinking as defined earlier is a combination of logical reasoning, problem solving, and reflection needed to demonstrate the

seven critical thinking skills required in respiratory care practice: prioritizing, anticipating, troubleshooting, communicating, negotiating, reflecting, and making decisions (Mishoe, 1994, 2003). The first principle in the definition of critical thinking is logical reasoning, which "covers a range of thought process that are primarily focused on the question of rational justification and explanation" (Mishoe & Welch, 2002, p. 34). This thought process can lead to deduction (deducing a conclusion based on the concordance of multiple reasons), induction ("a reasoning that is judged to be the best explanation that is plausible and consistent with the facts"), or inferential ("the ability that assumes one proposition is given and guessing that another proposition follows") reasoning (Mishoe & Welch, 2002, p. 36). In addition to logical reasoning, critical thinking is associated with problem solving. Problem solving involves cognitive, affective, and psychomotor behaviors. Cognitive behaviors are related to the analyzing, synthesizing, and evaluating that are used during the problem solving process (Mishoe & Welch, 2002). Affective behaviors include attitude, dispositions, and experience and psychomotor behaviors include physiological responding and reacting during problem solving, which are interrelated to cognitive and affective behaviors (Mishoe & Welch, 2002). The third important component associated with critical thinking is reflection, the ability to reflect and be reflective in performed actions. In other words, reflection is thinking about your thinking that examines the underlying assumptions, biases, and beliefs that leads to a new way of thinking and awareness (Mishoe

& Welch, 2002). The principles of logical reasoning, problem solving, and reflection are all needed for a respiratory therapist to think critically by prioritizing, anticipating, troubleshooting, communicating, negotiating, reflecting, and making decisions (Mishoe & Welch, 2002).

Understanding the concept of critical thinking helps in understanding the components of critical thinking of both respiratory care students and respiratory care faculty members, but it does not help us understand how respiratory care faculty members can promote students' critical thinking. Therefore, two concepts, mentoring and role modeling, were added to this study's conceptual framework based on the literature.

By looking to the academic settings, one can see that promoting students' critical thinking skills has become an expectation of faculty (Loving & Wilson, 2000; Wangensteen et al., 2010). Adams (1995) stated that "respiratory care educators must prepare their students for this expanded role in health care by teaching critical thinking" (p. 31). However, to promote students' critical thinking, faculty must first demonstrate good critical thinking skills (Robbins, 1988) given that one may not effectively promote something unless one has experience with it (Paul, 1992). Faculty can then foster students' critical thinking by effectively acting as mentors (Brookfield, 2012) and role models (Brookfield, 1987; 2012; Mishoe, 1993).

Mentoring is a relationship between a mentor (faculty in our case) and mentee (students in our case). According to Noe (1988), "the mentor is usually

a senior, experienced employee who serves as a role model, provides support, direction, and feedback to the younger employee regarding career plans and interpersonal development, and increase the visibility of the protégé [mentee] to decision-makers in the organization who may influence career opportunities" (p. 458). Since mentoring has been described as "the very life blood" of the respiratory care profession (Chatburn, 2004), good mentors will change the way students think and learn by challenging them to think critically and learn by inquiry and reflection (Zipp & Olson, 2008).

In addition to mentoring, faculty need to act as role models to foster students' critical thinking (Brookfield, 1987, 2012; Mishoe, 1993). A role model is a person whose behaviors are seen by other people as a good example or model to copy. Bandura's (1977) social learning behavior states that people tend to copy the behavior of their role models. Thus, students can emulate the way their faculties think if they see them as role models.

The conceptual framework of this study, as seen in Figure 1, helps in understanding the concept of critical thinking in the respiratory care context. It also shows that faculty should possess a higher level of critical thinking skills than students since they play an integral part as mentors and role models in promoting students' critical thinking skills.

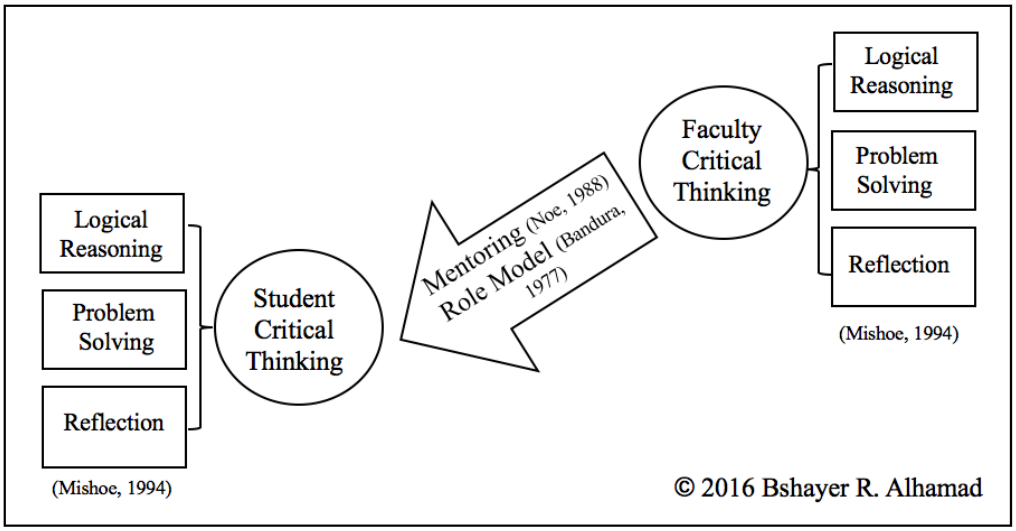

Figure 1. Conceptual framework of the study. This framework presents critical thinking composed of logical reasoning, problem solving, and reflection. It also shows that faculty should possess a higher level of critical thinking skills than students since they play an integral part as mentors and role models in promoting students' critical thinking skills.

Summary

Today, with the expanded role of respiratory therapists and the increased demands in health care, working as a competent respiratory therapist requires being a highly skilled, critically thinking professional who works with the inter-professtional health care teams to provide evidenced-based patient-centered care. In practice, respiratory therapists must have critical thinking skills mainly in dealing with three domains: patients, technology, and other health care providers (Mishoe, 2003).

Since critical thinking is the main proficiency to function as a respiratory

therapist, the critical thinking of respiratory care students must be fostered. However, this fostering will be difficult without an understanding of the concept of critical thinking and how it can be assessed. Many critical thinking definitions can be found in the literature, but the one that is considered the foundational framework with respect to critical thinking in respiratory care is from Mishoe (1994; 2003). Critical thinking is a combination of logical reasoning, problem solving, and reflection needed to demonstrate the seven critical thinking skills required in respiratory care practice: prioritizing, anticipating, troubleshooting, communicating, negotiating, reflecting, and making decisions (Mishoe, 1994; 2003).

The concept of critical thinking has sparked many researchers to develop tools to measure constructs noted in their definitions of critical thinking. These tools can be categorized into three types: general critical thinking instruments such as the WGCTA, CCTST, and CCTDI, health science critical thinking instruments such as the HSRT, and respiratory care instruments such as the clinical simulation exam of the NBRC examination, Shelledy et al.'s (2004a), and Goodfellow et al.'s (1999) tools. The WGCTA and CCTST have been widely used to assess the critical thinking of respiratory care and other health care students, but they measure general critical thinking and not critical thinking in the domain of health sciences since their questions are set in everyday scenarios. In terms of the critical thinking tools that are designed for respiratory care populations, the reliability and validity of the NBRC clinical

simulation exam have been questionable (Cullen et al., 2003); whereas Goodfellow et al.'s (1999) and Shelledy et al.'s (2004a) tools are not designed to be self-administered tests to measure the actual critical thinking skills, Goodfellow et al.'s (1999) tool is designed to measure perceived critical thinking and Shelledy et al.'s (2004a) tool is designed to be used by faculty to evaluate students' performance in critical thinking and problem solving. Until a self-administered instrument that measures the actual critical thinking specific to the respiratory care population is developed, the HSRT can be used since it is a reliable and valid tool designed specifically to measure critical thinking of health care students and professionals. To date, respiratory care students' critical thinking has been assessed using the HSRT in only two studies (Clark, 2012; Colletti, 2011). However, these studies had limitations that affected the results' generalizability and/or validity. Therefore, additional research is needed to assess the critical thinking of respiratory care students to get a glimpse into whether respiratory care students are sufficiently prepared to meet the health care demands projected by 2015 and Beyond.

In addition to assessing the critical thinking levels of students, researchers have also been interested to explore the factors that affect students' critical thinking. Using the WGCTA, the literature has reported a significant association among a strong science course background, respiratory GPA, clinical GPA, and the self-assessment examination of the certified respiratory test and critical thinking of respiratory care students. However,

years of experience correlate significantly but weakly to the anticipating, troubleshooting, and decision making skills of critical thinking for respiratory therapists (Goodfellow, 2001). Similarly, gender correlates significantly but weakly with only the troubleshooting skill (Goodfellow, 2001). Another relationship that attracts researchers is that between critical thinking and clinical simulation examination components (information gathering and decision making). However, the literature presents conflicting findings in this relationship that may refer to using the WGCTA in measuring critical thinking skills.

Also of interest in the literature is the lack of evidence to support the notion that respiratory care faculty have a good critical thinking level despite being expected to promote students' critical thinking. Based on the literature, respiratory care faculty can promote students' critical thinking by motivation and one strategy to motivate students is incorporating active learning in the classroom and clinical settings. Employing active learning strategies requires faculty to demonstrate critical thinking themselves. Therefore, it is important to assess faculty critical thinking skills as they play an integral part as mentors or facilitators in promoting students' critical thinking skills.

Based on these observed gaps in the literature, the first step in understanding and developing critical thinking in respiratory care is to assess the critical thinking skill levels of respiratory care students and respiratory care faculty members and to determine whether respiratory care faculty members

have stronger critical thinking skills than their students. Since critical thinking is a complex concept, gaining the perceptions of respiratory care students and faculty members in regard to what critical thinking is and how it can be developed can act in a supplemental role to further understand the main phenomenon of this study, which is critical thinking. Results of this study can be used to provide respiratory care educational programs with information needed to develop an educational environment that seeks to develop and advance students' critical thinking as a means to prepare them to be competent respiratory therapists who effectively meet the growing demands in health care to provide quality patient care.

Chapter III

METHODS

Design

This research used a mixed-methods design. This design is used when researchers "mix or combine quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 17). The researcher selected this design because a review of the literature suggested adding qualitative data to quantitative studies that explore critical thinking to gain insights that cannot be captured by quantitative data alone (Behar-Horenstein & Niu, 2011).

The specific type of mixed-methods design used was a concurrent embedded design. The concurrent embedded design is a one-phase design in which the researcher "mixes the different data sets [quantitative and qualitative] at the design level, with one type of data [quantitative or qualitative] being embedded within a methodology framed by the other data type (as cited in Creswell & Plano Clark, 2007, p. 67). "One data set [embedded] provides a supportive, secondary role in a study based primarily on the other data type" (as cited in Creswell & Plano Clark, 2007, p. 67). The collection and analysis of embedded data occur concurrently in no specific order, associating the data collection and analysis procedures with the predominant design and then integrating the information in the interpretation of the overall results (Creswell, 2009). In this study, the researcher embedded a qualitative component within

a quantitative design to act in a supplemental role within the overall quantitative design to aide in making sense of the data from a more global perspective.

When the data of this study were treated separately, the design of the quantitative data was descriptive, exploratory, and cross-sectional. The types of descriptive design used in this study were simple and comparative. The simple descriptive design involves describing a group of individuals on a set of variables (Portney & Watkins, 2009). For this study, the researcher described respiratory care students and respiratory care faculty by organizing and summarizing their demographic data. The other type of descriptive design used in this study was comparative descriptive. According to Taylor, Kermode, and Roberts (2006), comparative descriptive design is one in which two or more groups are compared on particular variables. Therefore, a comparative descriptive design was used to determine whether respiratory care faculty members have stronger overall critical thinking skills than respiratory care students. The design is exploratory because the researcher explored the overall critical thinking skill levels for both respiratory care students and respiratory care faculty by using the Health Sciences Reasoning Test (HSRT). Since data were collected from respiratory care students and respiratory care faculty at one point in time, the design was also cross-sectional.

For the qualitative data, three open-ended questions were included in the profile sheet section of the survey. In this study, the results obtained from the qualitative data were used to supplement the results of quantitative data,

thus helping us better understand the research problem. This type of qualitative data satisfies the meaning of concurrent embedded design.

Variables

The independent variables in this study were the type of participant: respiratory care students or respiratory care faculty and the demographic data (age, gender, ethnicity, higher degree earned, number of completed credit hours, number of clinical rotations, number of mentoring visits, considering their faculty as role models, whether their program teach students how to think critically, years of teaching experiences, years of working experience as a respiratory therapist, position of faculty, holding other responsibilities besides teaching, and engaging in training of how to promote critical thinking).

The dependent variable was the overall score achieved on the HSRT as a measure of critical thinking. The overall score of critical thinking skills is the total number of correct answers out of the 33 questions of the HSRT (Insight Assessment, 2016). The overall score was selected as the dependent variable rather than the five subscales of the HSRT because it is the best comprehensive measure of an individual's critical thinking, according to Insight Assessment, the company that owns the HSRT (Insight Assessment, 2016). The level of measurement for the overall score is the interval since it does not have a true zero point (i.e., if a participant has a score of zero, this score does not mean that the participant has no critical thinking at all).

Instrumentation

Participants completed one survey with two sections: HSRT and a profile sheet. The HSRT was purchased with permission for student testing from Insight Assessment.

Health Sciences Reasoning Test

The HSRT, evolved from the California Critical Thinking Skills Test (CCTST), is a standardized tool developed by Facione and Facione (2006) specifically to assess critical thinking skills for health care students and professionals (Insight Assessment, 2016.). It consists of 33 items. Each item begins with a short scenario framed in the health care context followed by multiple-choice question. Although the scenarios are set in the health care context, no prior knowledge of health care is required because the specialized information required to correctly answer questions is provided in the question stem itself (Insight Assessment, 2016). The HSRT questions ask test-takers to "draw inferences, to make interpretations, to analyze information, to draw warranted inferences, to identify claims and reasons, and to evaluate the quality of arguments" (Insight Assessment, n.d., para. 4). The HSRT is available in paper and online versions (Insight Assessment, 2016). However, this study used the online version to make it more convenient and feasible to reach respiratory care students and faculty from throughout the United States. The online HSRT is timed for 50 minutes, but a test-taker can submit their responses at any time during this period; however, if the 50 minutes ran, the

responses of the test-taker will be submitted automatically for scoring.

The HSRT reports six distinct critical thinking scores. Of these scores, five are considered subscales and one is an overall score. The overall score represents the total number of correct answers from the 33 questions and describes the overall strength of an individual's critical thinking skills. The five subscale scores of critical thinking are induction, deduction, analysis, inference, and evaluation; they are meant to identify which particular skill areas are strong and which are weaker and require consideration in subsequent training opportunities. According to the HSRT user manual (2016), induction is a process of reasoning in which we draw inference about what we think is probably true to reach a conclusion, so the conclusion reached is not always true. Deduction is a process of reasoning in which we reach a conclusion from the assumed truth of the premises, so the conclusion reached cannot be false if the premises are true. Analysis is the act of identifying elements of a situation and how they interact. Inference is the act of drawing conclusions from reasons and evidence that help in offering hypotheses, recommendations, or decisions. Evaluation is the act of appraisal used to assess the credibility of sources of information and the claims they make and the quality of arguments, analyses, interpretations, inferences, beliefs, and decisions. From the reported six scores of the HSRT, the overall score is the most important and reliable one as it comprehensively measures the critical thinking skills of an individual, making it consistent with the holistic conceptualization of critical thinking (Insight

Assessment, 2016). Critical thinking as a holistic concept means that it is not simply a list of discrete skills, but rather a process of intimately interconnected reasoning skills that lead to reflective judgment (Insight Assessment, 2016). Therefore, the best measure of one's critical thinking is the overall score as it treats critical thinking as a holistic concept and not as a list of separate cognitive skills.

According to the HSRT user manual (2016), each of the six scales do have a score range along with categorical interpretation. The overall score of the HSRT, which ranges from 0 to 33, is classified as "superior," "strong", "moderate," or "not-manifested" based on the score range into which that the test- taker's score falls. Test-takers whose overall score takes any number from 26 to 33 is categorized as "superior", who have the potential for more advanced learning and leadership. Test-takers whose overall score takes any number from 21 to 25 is categorized as "strong", who have the potential for academic success and career development. On the other hand, test-takers whose overall score takes any number from 15 to 20 is labelled as "moderate", who may experience challenges in reflective problem solving and reflective decision making related to learning and employment development. Finally, the results of test-takers whose overall score takes any number from 0 to 14 is in the "not-manifested" group suggest that, although they take the test, they may put in inadequate effort, suffer from cognitive fatigue, or have issues with either reading or language comprehension (Insight Assessment, 2016).

The categorical interpretation of each of the five subscales is classified as “strong,” “moderate,” or “not manifestoed” based on the score range into which that the test-taker’s score falls. For the deduction and induction subscales, a score of 8 or more is categorized as strong, scores of 5, 6, or 7 is labelled as moderate, and scores of 0, 1, 2, 3, or 4 is classified as not-manifested. For the analysis, inference, and evaluation subscales, a score of 5 or more is categorized as strong, scores of 3 or 4 is labelled as moderate, and scores of 0, 1, or 2 is classified as not-manifested (Insight Assessment, 2016).

The HSRT is a reliable and valid tool for measuring critical thinking; it has a Kuder Richardson (KR) Formula 20 internal consistency coefficient of .81 for the overall score, which exceeds the minimum threshold of strong KR-20 internal consistency (.70) for the instruments with multidimensional scales (Insight Assessment, 2016). The KR-20 for the subscales ranges from .52 to .77: inference (.52), analysis (.54), deduction (.71), induction (.76), and evaluation (.77) (Huhn et al., 2011). The KR-20 was used to measure reliability of the HSRT rather than the Cronbach’s alpha because KR-20 is used for dichotomously scored instrument and scales. Each answer of the HSRT was given 1 point for the correct answer and 0 for incorrect or unanswered item.

The HSRT content validity is based on the consensus definition of critical thinking identified in the APA Delphi study, which stated that "we understand critical thinking to be purposeful, self-regulating judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the

evidential, conceptual, methodological, criteriological, or contextual consideration upon which that judgment is based" (Facione, 1990, p. 2). The construct validity of the HSRT has been established by assessing the ability of the test to discriminate the critical thinking skills between expert and novice physical therapists (Huhn et al., 2011). Huhn et al. (2011) found that the HSRT was able to detect differences between experts and novices' overall score ($t_{(148)}$ = 2.67, p =.008), analysis subscale score ($F_{(1,150)}$ = 12.94, p = < .001), and deduction subscale score ($F_{(1,150)}$ = 5.96, p = .01). Additionally, the HSRT has also been able to detect changes in critical thinking scores of physical therapy students during their education. Statistically significant changes have been detected for the total score and for both the deductive and analysis subscale scores of critical thinking between entry of the program and before final affiliation. (Huhn, Black, Jensen, & Deutsch, 2013).

The HSRT was used in this study to measure critical thinking for both respiratory care students and faculty. This tool was selected over others because it is a reliable, valid, and designed specifically to measure critical thinking of health care science students and professionals and its five subscales (induction, deduction, inference, analysis, and evaluation) matched with the constructs in the Mishoe (1994) definition of critical thinking in respiratory care that guided this study. Mishoe (1994) defined critical thinking as “a combination of logical reasoning, problem solving, and reflection” (p. 501). The logical reasoning process includes deduction, induction, and inference and

these constructs are three of the constructs of HSRT. Problem solving and reflection in the definition of critical thinking involve analysis and evaluation and these are the other two constructs of the HSRT. Problem solving involves analysis and evaluation because the process of problem solving requires analyzing the problem and evaluating the alternative solutions to find the better solution. Furthermore, reflection encompasses the evaluation of our thinking, tasks, and situations to produce better thinking or become aware of mistakes and lessons.

In addition to the aforementioned strengths, the HSRT is the most appropriate tool for this study because although the Watson-Glaser Critical Thinking Appraisal (WGCTA) and CCTST are the most common tools mentioned in the literature, studies have revealed inconsistent results when utilizing them with health care populations, which may be because they are not-discipline specific; the questions on these tools rely on neutral topics of daily life and do not apply in the health care context (Johnson & Van Scoder, 2002; Hill, 2002; Wettstein et al., 2011). Therefore, studies have suggested that WGCTA and CCTST are appropriate tools for measuring critical thinking for the general population, but not necessarily the critical thinking of health care students and professionals (Shelledy et al., 2004b; Wettstein et al., 2011). Furthermore, the tools that measure critical thinking for respiratory care populations identified in the literature are not appropriate for this study because they have either questionable reliability and validity as in the clinical simulation

exam, the second part of the registered respiratory therapist credential examination (Cullen et al., 2003), or they do not help to address this study's research questions, like the tools in Goodfellow et al. (1999) and Shelledy et al. (2004a). For example, Goodfellow et al.'s (1999) tool measures perceived critical thinking and not actual critical thinking skills, which this study looks to do. Likewise, Shelledy et al.'s (2004a) tool is not a self-administered test that measures actual critical thinking; however, it is designed to be used by faculty to evaluate students' performance in critical thinking and problem solving.

Profile Sheet

The HSRT allows for 10 additional questions to be asked over its standard demographic questions (i.e., age, gender, ethnicity, email, name). The principal investigator asked Insight Assessment to remove the questions that asked the participants about their names and emails to protect their identity and privacy. Of the 10 additional questions created by the principal investigator, 7 were demographic in the form of closed-ended questions with the purpose of describing the characteristics of the participants and were based on the type of participant, whether students or faculty. Respiratory care students were asked to state their educational degree, number of completed credit hours and clinical courses, frequency of meeting with their faculty advisors, whether they consider their faculty as role models, whether their program teaches them critical thinking, and years of working as respiratory therapists if applicable. Respiratory care faculty were asked to state their educational degree, rank,

type of employment, years of experience as faculty and as respiratory therapists, whether they hold other responsibilities in addition to teaching, and whether they engaged in advance training in how to promote students' critical thinking. The remaining three questions were embedded in the form of open-ended questions intended to obtain qualitative data to supplement the quantitative data to help better understanding the research problem (Appendix D for student profile sheet and Appendix E for faculty profile sheet).

Setting

The research was conducted online through an Internet browser in the place of choice by the participants; they only needed Internet access.

Sample

Participant and Selection Criteria

The study had two participant groups: (1) respiratory care faculty and (2) respiratory care students. The two participant groups were included in or excluded from the study based on the criteria listed below.

Inclusion Criteria:

1) Respiratory care faculty members must be a minimum of 21 years of age and currently teaching in any accredited respiratory care program in the United States.
2) Respiratory care students must be a minimum of 18 years of age and currently enrolled in any accredited respiratory care program in the United States.

3) All participants must have Internet access.

Exclusion Criteria:

1) Respiratory care faculty members are excluded if they are currently teaching in a non-accredited respiratory care program in the United States.
2) Respiratory care students are excluded if they are currently enrolled in a non-accredited respiratory care program in the United States.
3) Participants who do not have Internet access are excluded.

Study Protocol

Upon receipt of the study approval from the Institutional Review Board at Seton Hall University, the primary investigator sent an email to the directors of all the accredited respiratory care programs in the United States, as identified within the Commission on Accreditation for Respiratory Care (CoARC) website. Program directors' contact information (emails) is provided to the public on this site.

The email explained the study, requested directors' participation in the study since they were faculty, and asked the directors to forward the two attached letters of solicitation to their current respiratory care students and faculty members (one attachment for students and the other for faculty members).

The letter of solicitation attached in the email included all the required National Institutes of Health items, such as affiliation, voluntary participation,

and confidentiality. It also included an active link that directed the participants to the Insight Assessment online testing system where they could complete the online survey. Additionally, the letter of solicitation designed for each group of participants (students and faculty) provided a unique login and password along with instructions for the participants on how to access and complete the online survey. Submission of the online survey by the participants implied their consent to participate in the study.

Since participation in this study was voluntary, if participants decided not to participate, the process ended. If they decided to participate, they accessed the secure, encrypted Insight Assessment online testing interface using the unique login and password provided to them and completed the two sections of the online survey (HSRT and profile sheet) in a place of their choice providing Internet access. After the submission of the online survey, participant's results automatically appeared on the screen and they were given the option of printing results for their personal use.

The recruitment period was open for two months to allow participants to voluntarily complete the survey at their preferred time. During the recruitment period, the primary investigator sent out two reminder emails in addition to the original study invitation to the directors of the respiratory care programs every two weeks, to remind them to participate and to ask them to forward the solicitation letters to their current respiratory care students and faculty to encourage participation in the survey. Due to low response rate, the primary

researcher decided to modify the recruitment method. Thus, instead of sending a reminder email to the programs' directors who acted as gatekeepers for the forwarding of the solicitation letters to their program respiratory care students and faculty members, a direct invitation email was sent to respiratory care faculty members whose emails were found in their schools' website. Additionally, these faculty were asked to forward the solicitation letter directly to their students, thus using a snow-ball sampling method.

After the recruitment period ended, the primary researcher accessed the Insight Assessment account using a unique login and password and retrieved the HSRT score participant de-identified package. The HSRT score package includes two files. One file houses the data in a spreadsheet form reporting the six distinct scores on the HSRT, the percent of questions answered, time spent on the assessment, percentile score for each individual participant in the group, and the responses of each participant to the profile sheet questions. The other file is in a portable document file (PDF) format and reports basic descriptive statistics for the participant group for the six distinct scores on the HSRT, presented in a tabular format along with histogram charts for the HSRT six scores. The primary investigator took the quantitative data and entered them into SPSS for analysis and analyzed the qualitative data using content analysis.

Data Analysis

According to Creswell and Plano Clark (2007), "Data analysis in mixed methods research consists of analyzing the quantitative data using quantitative

methods and the qualitative data using qualitative methods" (p. 128). This means that the quantitative data from the HSRT and profile sheet were analyzed using quantitative analysis whereas the qualitative data from the three open-ended questions were analyzed using qualitative analysis methods. After the analysis was conducted, all data were merged to interpret the results.

Quantitative Data Analysis

The quantitative data were analyzed using both descriptive and inferential statistics, using SPSS Version 23.

Descriptive statistics were used to describe the demographic characteristics of the participants; they were presented in tabular form to report measures of spread and central tendency (mean, standard deviation, frequency, and percentages) (Portney & Watkins, 2009). Descriptive statistics were also used to describe participants' critical thinking scores on the HSRT (mean, median, standard deviation, first and third quartile, minimum, and maximum).

In terms of inferential statistics and according to Portney and Watkins (2009), the parametric independent *t*- test is used when the means of two independent groups of subjects are compared. Therefore, the independent *t*-test was used to determine whether respiratory care faculty members have stronger overall critical thinking skills than respiratory care students.

For the statistical analysis, the α level was fixed at 0.05. and the β level at 0.2 with a corresponding power of .80, as Portney and Watkins (2009) suggested, to protect against type II error.

Qualitative Data Analysis

For the qualitative data obtained from the responses to the three open-ended questions, content analysis was used to interpret the meaning of the content. Content analysis is "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p. 1278). Using content analysis for the qualitative data allowed us to "attain condensed and broad description of the phenomenon" (Elo & Kyngäs, 2008, p. 108).

Content analysis "begins with the identification of units or segments of data that seem important or meaningful in some way" (Maxwell, 2013, p. 107). The next step includes developing a categorization matrix that is generally based on earlier work such as theories and literature reviews (as cited in Elo & Kyngäs, 2008). "After a categorization matrix has been developed, all the data are reviewed for content and coded correspondence with or exemplification of the identified categories" (as cited in Elo & Kyngäs, 2008, p. 111). This kind of coding is called theory-driven coding. A strategy called data-driven coding was also used to identify new theme emerged from the participants' responses. "Data-driven coding involves reading the data and developing new coding categories, based on what data seen most important" (Maxwell, 2013, p.107).

Chapter IV

RESULTS

The Insight Assessment company designates an HSRT assessment as "complete" when at least 60% of the questions are answered and a minimum of 15 minutes are spent on the assessment. Based upon these criteria, data from 22 of the 26 respiratory care students who volunteered to participate in this study were utilized in data analysis. Four students failed to qualify and were excluded. Of these, three students spent less than 15 minutes and the fourth answered less than 60% of the questions.

In terms of the respiratory care faculty member group, 27 faculty members volunteered to participate in this study. However, seven were excluded since they did not meet the requirements of the Insight Assessment. Specifically, five faculty members spent less than 15 minutes and the remaining two answered less than 60% of the questions. Elimination of these faculty left a final sample size of 20 respiratory care faculty members included for data analysis.

To determine the power of this study, a post-hoc analysis using G*Power software was conducted (Figure 2). The result of this analysis showed that the study had a power of .81, which exceeds the recommended power level of .80 for studies in the health and social sciences (Cohen, 1988, 1992). This study exceeded the recommended power level of .80 despite having a small sample size (22 respiratory care students and 20 respiratory care faculty members)

because the calculated effect size was .79, very close to Cohen's *d* of .80 and this is considered a large effect size (Cohen, 1988). Since effect size has an inverse relationship with sample size, a large effect size as in this study needs a small sample size to reach the recommended power (Sullivan & Feinn, 2012).

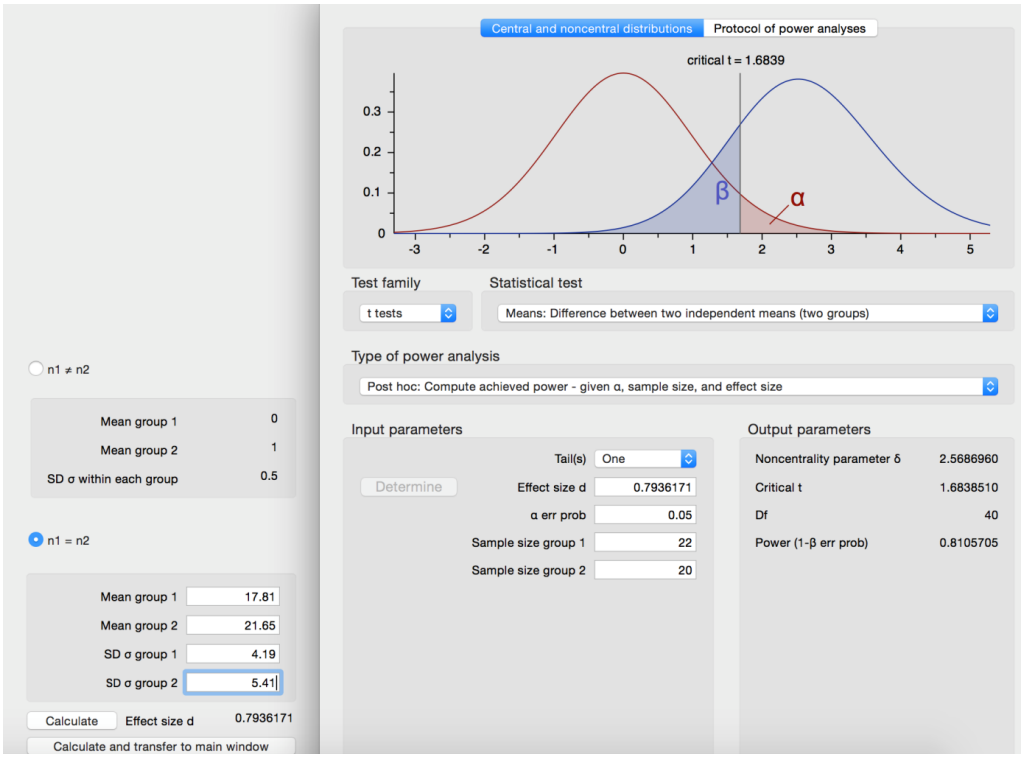

Figure 2. Post-hoc G*Power analysis for the independent samples *t*-test. The figure shows that the study has a power of .81, which exceeds the recommended power of .80, and a large effect size of .79.

Quantitative Results

Characteristics of Respiratory Care Student Group

The age of the respiratory care student group ranged from 21 to 42. The average age was calculated as 26.31 years, with a standard deviation of 5.45. In regard to gender, the respiratory care students group was roughly equally distributed between females and males (12 females, 54.54%, and 10 males, 45.45%). The majority of respiratory care students identified themselves as white, Caucasian, or Anglo American (12 students, 45.45%). The second highest ethnicity group reported was the category of other (seven students, 31.82%). Unfortunately, we do not know what "other" is since the Insight Assessment system does not allow the researcher to add an open space for participants to identify "other" when they select this option. One student (4.55%) self-reported his or her ethnicity as black, African American. One student (4.55%) self-reported his or her ethnicity as Asian, Asian American, or Pacific Islander. One student (4.55%) chose not to answer.

Nearly half of the students (12 students, 54.55%) will earn an associate's degree after completing their current respiratory care program. This finding was not surprising because 85% of the accredited respiratory care programs offer an associate's degree. The other half of the student group was equally divided between earning a bachelor's (five students, 22.73%) or a master's degree (five students, 22.73%) after completing their current respiratory care programs.

In terms of the number of credit hours earned, respiratory care students were distributed in all the categories of credit hours, with the highest percentage (36.36%, eight students) having earned from 60-89 credit hours, followed by 22.73% (five students) with 90-119 credit hours; 18.18% (four students) with less than 30 credit hours, 13.64% (three students) with 120 or more credit hours, and 9.09% (two students) with 30-59 credit hours.

All the students had completed at least one clinical rotation except for three (13.64%) who did not complete any. For those who completed clinical rotations, seven students (31.82%) completed more than four clinical rotations, four (18.18%) completed three clinical rotations, three (13.64%) completed four clinical rotations, three (31.64%) completed one clinical rotation, and two (9.09%) completed two clinical rotations.

In regard to the number of years they have worked as a respiratory therapist, the majority of students (68.18%, 15 students) selected the option of not applicable as was expected. However, four (18.18%) reported that they had worked as a respiratory therapist from 1-5 years whereas three students (13.64%) reported that they had done so for less than 1 year. Based upon their responses, it appears the students did not adequately read the question posed or they may have been respiratory therapists and returning for higher academic degree status, which we did not account for in this study.

For the question regarding whether their programs teach them how to think critically, all the students reported that their programs do so, with 14

(63.64%) reporting that critical thinking is integrated into their courses and the other eight (36.36%) reporting that their program offers an independent critical thinking course.

For the question asking about the frequency of meeting with their faculty advisor, all students reported that they meet with their faculty advisor: 10 students (45.45%) meet sometimes with their faculty advisors, six (27.27%) meet often with their faculty advisors, five (22.73%) always meet with their faculty advisors, and only one (4.55%) meets rarely with his or her faculty advisor.

For the question regarding whether they considered their respiratory care faculty as role models, all students reported that they did except for two students (9.09%). Of the students who considered their faculty to be role models, 10 (45.45%) considered all their faculty members as role models whereas the other 10 (45.45%) considered only some of their faculty as role models.

Table 1 summarizes the demographic characteristics of the respiratory care student group.

Table 1
Demographic Characteristics of the Respiratory Care Student Group

Demographics	Frequency (n=22)	Percent
Gender		
Female	12	54.54%
Male	10	45.45%
Choose not to provide answer	---	---
Ethnicity		
White, Caucasian, Anglo American	12	45.45%
Black, African American	1	4.55%
Asian, Asian American, Pacific Islander	1	4.55%
Indian American	---	---
Hispanic	---	---
Other	7	31.82%
Educational Degree		
Associate Degree	12	54.55%
Baccalaureate Degree	5	22.73%
Master Degree	5	22.73%
Number of Credit Hours		
<30	4	18.18%
30-59	2	9.09%
60-89	8	36.36%
90-119	5	22.73%
120 and more	3	13.64%
Number of Clinical Rotations		
0	3	13.64%
1	3	13.64%
2	2	9.09%
3	4	18.18%
4	3	13.64%
>4	7	31.82%
Years Working as Respiratory Therapist		
Not Applicable	15	68.18%
<1 year	3	13.64%
1-5 years	4	18.18%
6-10 years	---	---
10-15 years	---	---
16-20 years	---	---

Whether their program teaches them critical thinking		
Yes, critical thinking is integrated in our courses	14	63.64%
Yes, we have a critical thinking course	8	36.36%
Yes, critical thinking is integrated in our courses AND we have a critical thinking course	---	---
No, our program does not teach us critical thinking	---	---
Frequency of Meeting with Faculty Advisor		
Never	---	---
Rarely	1	4.55%
Sometimes	10	45.45%
Often	6	27.27%
Always	5	22.73%
Whether they consider their faculty as role models		
Yes, all of them	10	45.45%
Yes, some of them	10	45.45%
No, none of them	2	9.09%

Critical Thinking Skills Level of Respiratory Care Students: Research Question 1

Before presenting the results of HSRT scores, test-takers' behavior will be reported. Test-takers' behavior includes the time the test-taker spent on the HSRT in minutes and the percentage of questions answered by the test-takers. The time the test-takers spent on the HSRT is counted from opening the first test question of the HSRT until the test-taker submits all responses to this test. It does not include the time the test-taker may have spent completing profile sheet questions prior to beginning the test itself. The time respiratory care students spent in completing the HSRT ranged from 22 to 50 minutes (the

minimum time the test-taker should spend for us to include the HSRT responses in analysis is 15 minutes and the maximum time allotted to complete the HSRT is 50 minutes). The average amount of time spent was 39.77 minutes with a standard deviation of 10.03. In terms of percentage of questions answered, respiratory care students answered in the range from 61% to 100%.

The HSRT reports six distinct critical thinking scores: induction, deduction, analysis, inference, evaluation, and overall score. Of these scores, the overall score is the best measure of critical thinking as it comprehensively measures the critical thinking skills of an individual, making it consistent with the holistic conceptualization of critical thinking.

The overall score on the HSRT represents the number of correct answers out of 33 questions and describes the overall critical thinking strengths of an individual. The respiratory care student group's (n = 22) descriptive statistics for the overall critical thinking score were as follows: out of 33, the mean was 17.81, with a standard deviation of 4.19. The median score was 19, and the mode score was 22. The overall score in this group ranged from 8 (minimum score) to 24 (maximum score). The 25th percentile for this group (Quartile1) was 15 and the 75th percentile score (Quartile 3) was 22. Using the recommended cut scores for categorical interpretation of the HSRT overall score provided in the HSRT user manual (2016), a mean overall score of 17.81 represents a moderate range. Figure 3 displays the overall score distribution of the respiratory care student group.

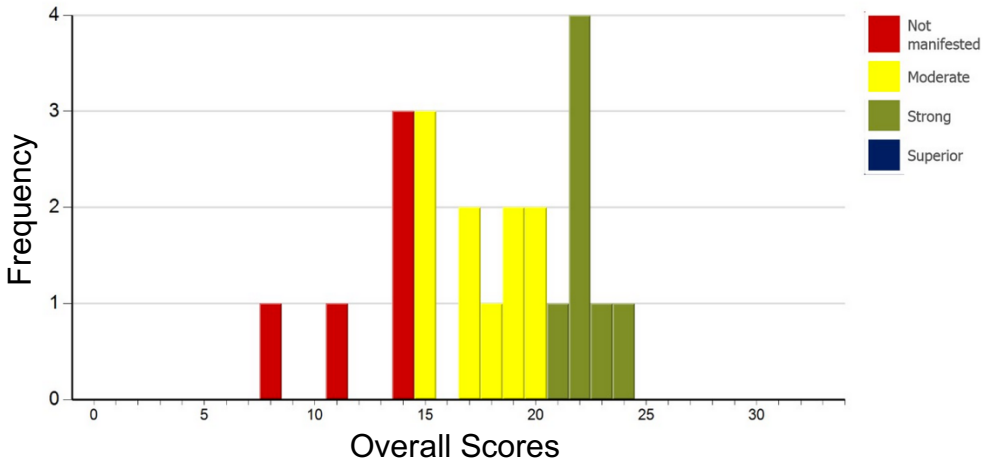

Figure 3. Histogram for the overall critical thinking score on the HSRT of the respiratory care student group. The histogram shows that five students did not manifest overall critical thinking skills, represented by red bars. Ten displayed moderate overall critical thinking skills, represented by yellow bars. Seven fell into the strong overall critical thinking level, represented by green bars. No student in this respiratory care student group displayed superior overall critical thinking skills.

The overall scores of the respiratory care student sample of this study were compared to an external benchmark comparison group via percentile ranking score provided by the Insight Assessment. In this study, the overall scores of respiratory care students have been compared to national comparison percentiles for HSRT undergraduate health sciences students. This comparison group was chosen by the client (primary investigator) because it is the most appropriate comparison group available in the Insight Assessment to benchmark this study sample of respiratory care students. The comparison

percentile scores of the respiratory care student sample ranged from the 1st to the 80th percentile. The mean percentile score for this group was 38. This score means that roughly 37 undergraduate health sciences students out of 100 will score lower than this sample of respiratory care students and 62 undergraduate health sciences students out of 100 will score higher than this sample of respiratory care students.

Although the five subscale scores are not part of the present study research questions, their descriptive statistics were reported. Summarizing the results of respiratory care students via the subscale scores can further help to identify the strengths and weaknesses in students' critical thinking. Finally, training and development programs can use this information to target the weaknesses areas for improvement.

Induction: The respiratory care student group's mean score on induction was 6.5, with a standard deviation of 1.7. The median score was 7.0. The minimum score was 3 and the maximum score was 9. The 25th percentile for this group (Quartile1) was 6 and the 75th percentile score (Quartile 3) was 8. Using the recommended cut scores for categorical interpretation of the HSRT induction score provided in the HSRT user manual (2016), a mean induction score of 6.5 represents a moderate range. Figure 4 displays the induction score distribution of the respiratory care student group.

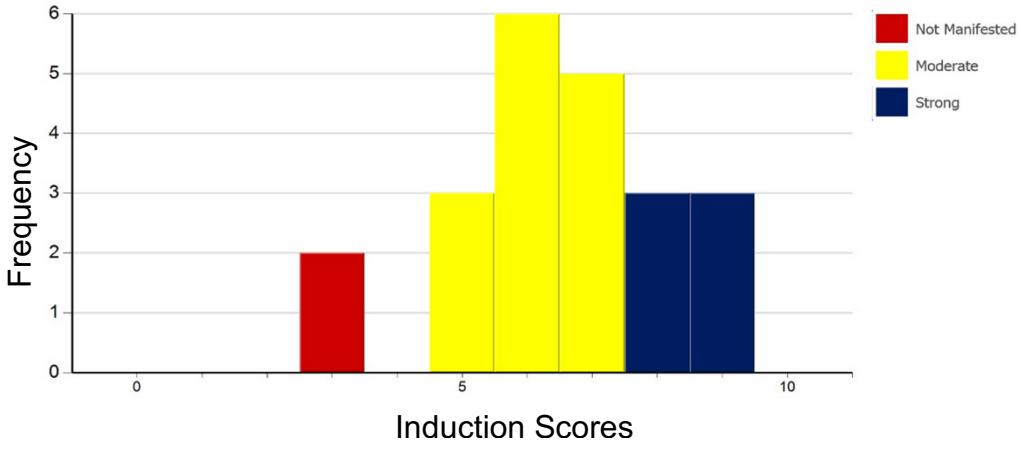

Figure 4. Histogram for the induction score of the respiratory care student group. This histogram shows that 14 students scored in the moderate range, represented by yellow bars. Six scored in the strong range, represented by blue bars, and two scored in the not-manifested range, represented by the red bar.

Deduction: The respiratory care student group's mean score on deduction was 4.6, with a standard deviation of 2.0. The median score was 4.0. The minimum score was 1 and the maximum score was 9. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 6. Using the recommended cut scores for categorical interpretation of the HSRT deduction score provided in the HSRT user manual (2016), a mean deduction score of 4.6 is considered to be between not-manifested and the moderate range. Figure 5 displays the deduction score distribution of the respiratory care student group.

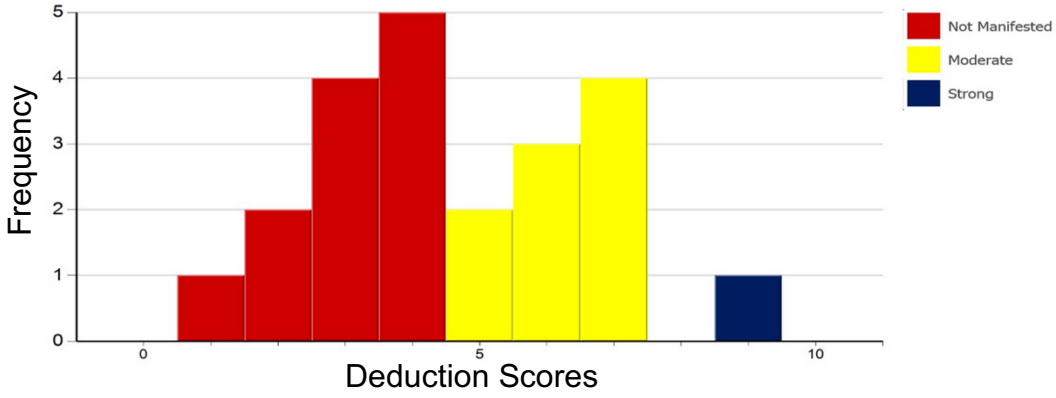

Figure 5. Histogram for the deduction score of the respiratory care student group. This histogram shows that 12 students scored in the not-manifested range, represented by red bars. Nine scored in the moderate range, represented by yellow bars. Only one scored in the strong range, represented by the blue bar.

Analysis: The respiratory care student group's mean score on analysis was 3.6, with a standard deviation of 1.5. The median score was 4.0. The minimum score was 1 and the maximum score was 6. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 5. Using the recommended cut scores for categorical interpretation of the HSRT analysis score provided in the HSRT user manual (2016), a mean analysis score of 3.6 is considered to be in the moderate range. Figure 6 displays the analysis score distribution of the respiratory care student group.

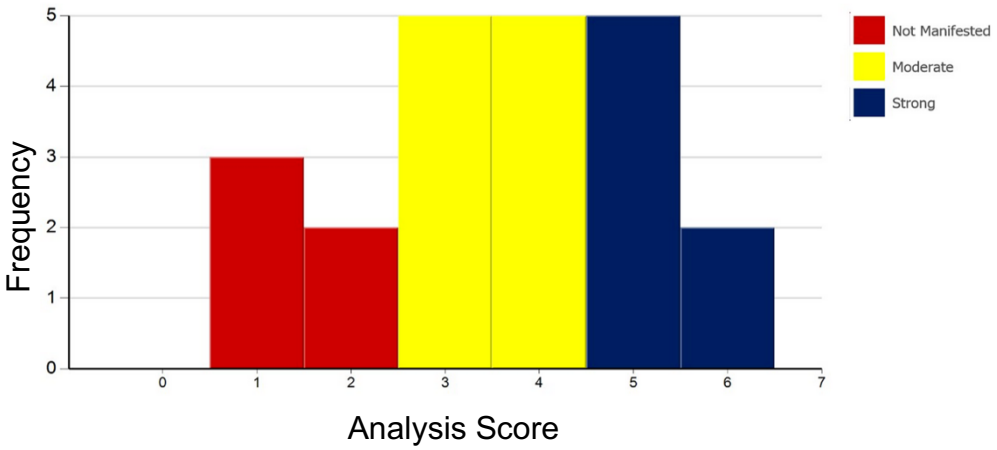

Figure 6. Histogram for the analysis score of the respiratory care student group. This histogram shows that 10 students scored in the moderate range, represented by yellow bars. Seven scored in the strong range, represented by blue bars, and five scored in the not-manifested range, represented by red bars.

Inference: The respiratory care student group's mean score on inference was 3.4, with a standard deviation of 1.0. The median score was 3.0. The minimum score was 1 and the maximum score was 5. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 4. Using the recommended cut scores for categorical interpretation of the HSRT inference score provided in the HSRT user manual (2016), a mean inference score of 3.4 is considered to be in the moderate range. Figure 7 displays the inference score distribution of the respiratory care student group.

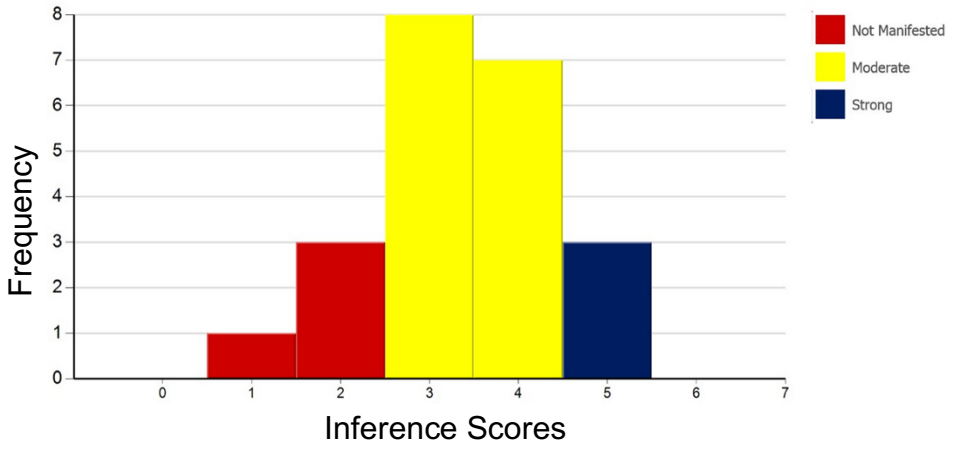

Figure 7. Histogram for the inference score of the respiratory care student group. This histogram shows that 15 students scored in the moderate range, represented by yellow bars. Four scored in the not-manifested range, represented by red bars, and three scored in the strong range, represented by the blue bar.

Evaluation: The respiratory care student group's mean score on evaluation was 4.0, with a standard deviation of 1.3. The median score was 4.0. The minimum score was 2 and the maximum score was 6. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 5. Using the recommended cut scores for categorical interpretation of the HSRT evaluation score provided in the HSRT user manual (2016), a mean evaluation score of 4.0 is considered to be in the moderate range. Figure 8 displays the evaluation score distribution of the respiratory care student group.

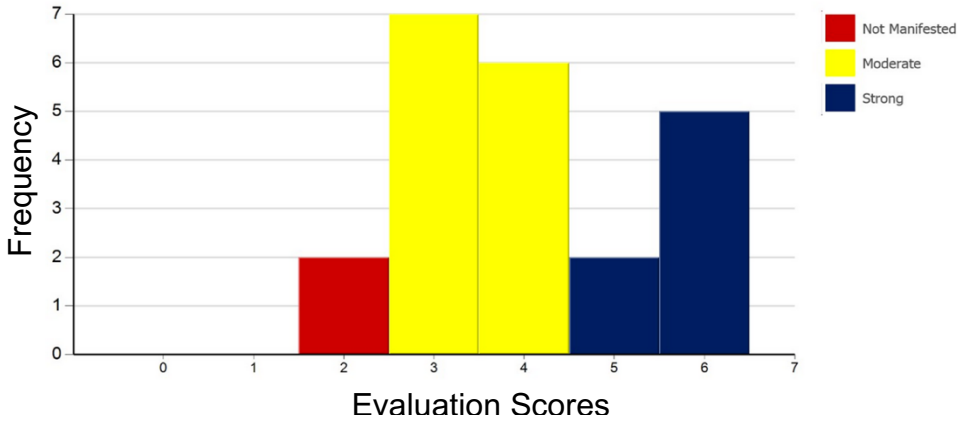

Figure 8. Histogram for the evaluation score of the respiratory care student group. This histogram shows that 13 students scored in the moderate range, represented by the yellow bars, followed by seven who scored in the strong range, represented by blue bars, and only two who scored in the not-manifested range, represented by the red bar.

Characteristics of Respiratory Care Faculty Member Group

The age of the respiratory care faculty member group ranged from 35 to 70. The average age was calculated as 52.8 years, with a standard deviation of 10.18. In regard to gender, most participating faculty members were female (13 faculty members, 65%) and the remaining seven (35%) were male. All of the faculty members identified themselves as white, Caucasian, or Anglo American (20 faculty members, 100%). In terms of highest educational degree earned, nearly half the faculty (nine faculty members, 45%) hold a master's degree. five (25%) hold a bachelor's degree, five (25%) hold a doctorate degree and one (5%) faculty member holds a professional degree.

Regarding their rank as a faculty member, six faculty members (30%) were assistant professors, five (25%) were clinical instructors, and four (20%) fell into the category of other. Unfortunately, we do not know what other means since the Insight Assessment system does not allow the researcher to add an open space for the participants to identify “other” when they select this option. Three faculty members (15%) were professors and two (10%) were associate professors.

In terms of employment status, most participating faculty members were employed full-time (17 faculty members, 85%) with only three (15%) employed part-time.

In terms of teaching experience, four faculty members (20%) have taught more than 30 years, four (20%) have taught for 6-10 years, three faculty members (15%) have taught for 16-20 years, three (15%) have taught for 11-15 years, three faculty members (15%) have taught for 1-5 years, two faculty members (10%) have taught for 21-25 years, and only one (5%) has taught for 25-30 years.

When asked whether they have other responsibilities in addition to teaching, such as management, administration, and leadership, most of the faculty members answered yes (18 faculty members, 90%) with only two (10%) answering no.

In terms of number of years they have worked as a respiratory therapist, seven reported (35%) working more than 30 years, six (30%) reported 26-30

years, three (15%) reported 21-25 years, two (10%) reported 11-15 years, one (5%) reported 16-20 years, and one faculty member (5%) reported working for 6-10 years.

For the question regarding whether they have engaged in training on how to promote students' critical thinking, most of the faculty members reported that they have training, with nine of them (45%) engaged in informal training and seven (35%) engaged in formal training. Only four faculty members (20%) reported that they had not engaged in any type of training on how to promote students' critical thinking.

Table 2 summarizes the demographic characteristics of the respiratory care faculty group.

Table 2
Demographic Characteristics of the Respiratory Care Faculty Group

Demographics	**Frequency (n=20)**	**Percent**
Gender		
Female	13	65%
Male	7	35%
Choose not to provide answer	---------	--------
Ethnicity		
White, Caucasian, Anglo American	20	100%
Black, African American	---------	--------
Asian, Asian American, Pacific Islander	---------	--------
Indian American	---------	--------
Hispanic	---------	--------
Other	---------	--------

Educational Degree		
Baccalaureate Degree	5	25%
Master Degree	9	45%
Professional Degree	1	5%
Doctorate Degree	5	25%
Rank		
Clinical Instructor	5	25%
Lecturer	---	---
Assistant Professor	6	30%
Associate Professor	2	10%
Professor	3	15%
Other	4	205
Employment Status		
Full-time	17	85%
Part-time	3	15%
Teaching Experience		
<1 year	---	---
1-5 years	3	15%
6-10 years	4	20%
10-15 years	3	15%
16-20 years	3	15%
21-25 years	2	10%
26-30 years	1	5%
>30 years	4	20%
Other Responsibilities in Addition to Teaching		
Yes	18	90%
No	2	10%
Years of Working as Respiratory Therapist		
Not Applicable	---	---
<1 year	1	4.55%
1-5 years	10	45.45%
6-10 years	1	5%
11-15 years	2	10%
16-20 years	1	10%
21-25 years	3	15%
26-30 years	6	30%
>30 years	7	35%

Whether they train on how to promote students' critical thinking		
Yes, engaged in informal training	9	45%
Yes, engaged in formal training	7	35%
Not engaged in any training	4	20%

Critical Thinking Skills Level of Respiratory Care Faculty Members: Research Question 2

Before presenting the results of HSRT scores, test-takers' behavior will be reported. test-takers' behavior includes the time the test-takers spent on the HSRT in minutes and the percentage of questions answered by the test-takers. The time the test-takers spent on the HSRT is counted from opening the first test question of the HSRT until the test-taker submits all responses to this test. It does not include the time the test-taker may have spent completing profile sheet questions prior to beginning the test itself. The time respiratory care faculty spent in completing the HSRT ranged from 22 to 50 minutes (the minimum time the test-taker should spend for us to include the HSRT responses in analysis was 15 minutes and the maximum time allotted to complete the HSRT is 50 minutes). The average amount of time spent was 39.70 minutes, with a standard deviation of 10.15. In terms of percentage of questions answered, respiratory care faculty members answered in the range from 64% to 100%.

The HSRT reports six distinct critical thinking scores: induction, deduction, analysis, inference, evaluation, and overall score. Of these scores,

the overall score is the best measure of critical thinking as it comprehensively measures the critical thinking skills of an individual, making it consistent with the holistic conceptualization of critical thinking.

The overall score on the HSRT represents the number of correct answers out of 33 questions and describes the overall critical thinking strengths of an individual. The respiratory care faculty member group's (n = 20) descriptive statistics for the overall critical thinking score were as follows: Out of 33, the mean was 21.65, with a standard deviation of 5.41. The median score was 23 and the mode scores were 25, 27, and 28. The overall score in this group ranged from 11 (minimum score) to 28 (maximum score). The 25th percentile for this group (Quartile 1) was 17 and the 75th percentile score (Quartile 3) was 27. Using the recommended cut scores for categorical interpretation of the HSRT overall score provided in the HSRT user manual (2016), a mean overall score of 21.65 represents a strong range. Figure 9 displays the overall score distribution of the respiratory care faculty group.

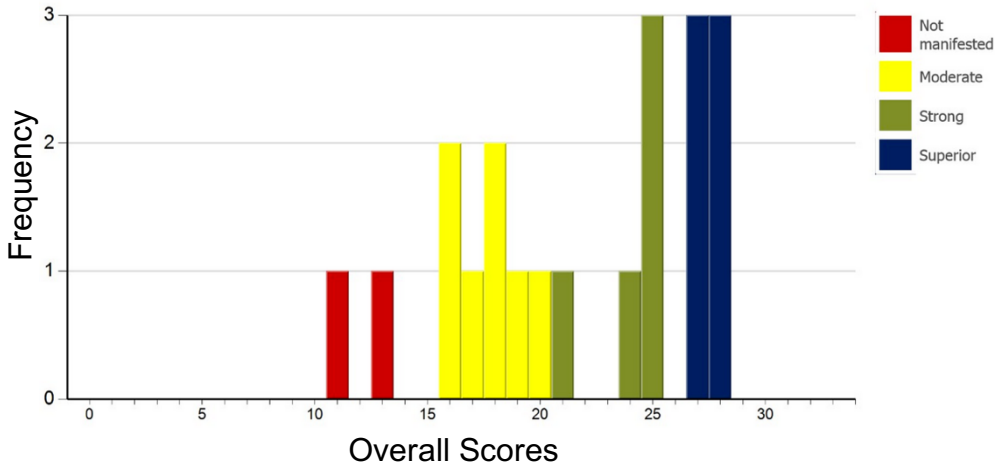

Figure 9. Histogram for the overall critical thinking score of the respiratory care faculty group. This histogram shows that two faculty members scored in the not-manifested range, represented by red bars. Seven scored in the moderate range, represented by yellow bars. Five scored in the strong range, represented by green bars, and six scored in the superior range, represented by blue bars.

The overall scores of the respiratory care faculty sample of this study were compared to an external benchmark comparison group via the percentile ranking score provided by the Insight Assessment. In this study, the overall scores of respiratory care faculty have been compared to the national comparison percentile for HSRT graduate health sciences students. This comparison group was chosen by the client (primary investigator) because it is the most appropriate comparison group available in the Insight Assessment. The comparison percentile scores of the respiratory care faculty sample ranged from the 2nd to the 91st percentile. The mean percentile score for this group was 47. This score means that roughly 46 graduate health sciences students

out of 100 will score lower than this sample of respiratory care faculty and 53 graduate health sciences students out of 100 will score higher than this sample of respiratory care faculty.

Although the five subscale scores are not part of the present study research questions, their descriptive statistics were reported. Summarizing the results of respiratory care faculty via the subscale scores can further help to identify the strengths and weaknesses in faculty critical thinking. Finally, training and development programs can use this information to target the weaknesses areas for improvement.

Induction: The respiratory care faculty member group's mean score of induction was 7.4, with a standard deviation of 1.7. The median score was 8.0. The minimum score was 4 and the maximum score was 10. The 25th percentile for this group (Quartile1) was 6 and the 75th percentile score (Quartile 3) was 9. Using the recommended cut scores for categorical interpretation of the HSRT induction score provided in the HSRT user manual (2016), a mean induction score of 7.4 is considered to be in the moderate to strong range. Figure 10 displays the induction score distribution of the respiratory care faculty group.

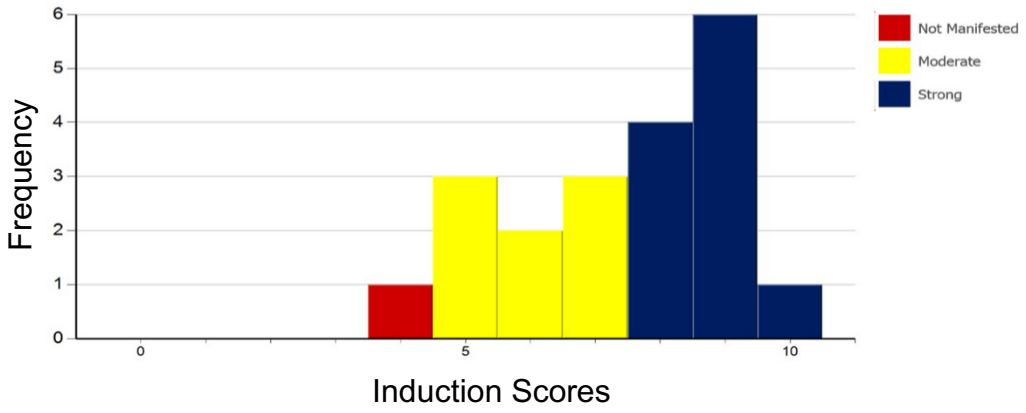

Figure 10. Histogram for the induction score of the respiratory care faculty group. Eleven faculty members scored in the strong range, represented by blue bars, followed by eight in the moderate range, represented by yellow bars, and only one in the not-manifested range, represented by the red bar.

Deduction: The respiratory care faculty member group's mean score of deduction was 6.6, with a standard deviation of 2.5. The median score was 7.0. The minimum score was 2 and the maximum score was 10. The 25th percentile for this group (Quartile1) was 5 and the 75th percentile score (Quartile 3) was 9. Using the recommended cut scores for categorical interpretation of the HSRT deduction score provided in the HSRT user manual (2016), a mean deduction score of 6.6 represents a moderate level. Figure 11 displays the deduction score distribution of the respiratory care faculty group.

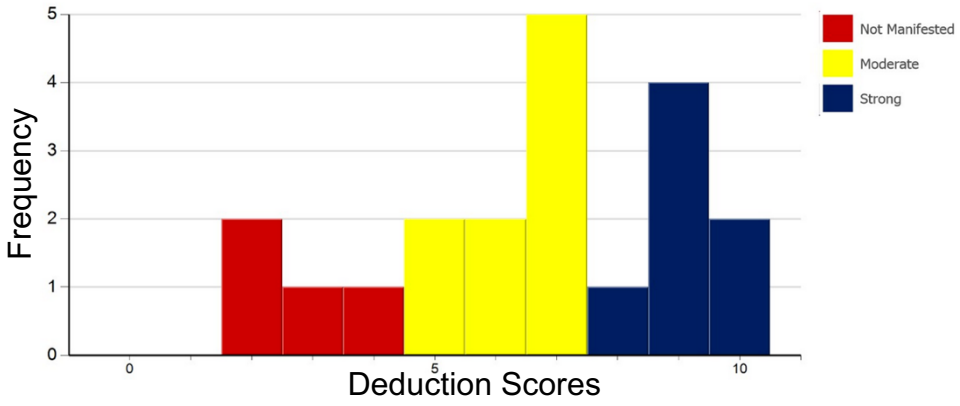

Figure 11. Histogram for the deduction score of the respiratory care faculty group. This histogram shows that nine faculty members scored in the moderate range, represented by yellow bars, followed by seven in the strong range, represented by blue bars, and only four in the not-manifested range, represented by red bars.

Analysis: The respiratory care faculty member group's mean score of analysis was 4.7, with a standard deviation of 1.3. The median score was 5.0. The minimum score was 1 and the maximum score was 6. The 25th percentile for this group (Quartile1) was 4 and the 75th percentile score (Quartile 3) was 6. Using the recommended cut scores for categorical interpretation of the HSRT analysis score provided in the HSRT user manual (2016), a mean analysis score of 4.7 is considered to be in the moderate to strong range. Figure 12 displays the analysis score distribution of the respiratory care faculty group.

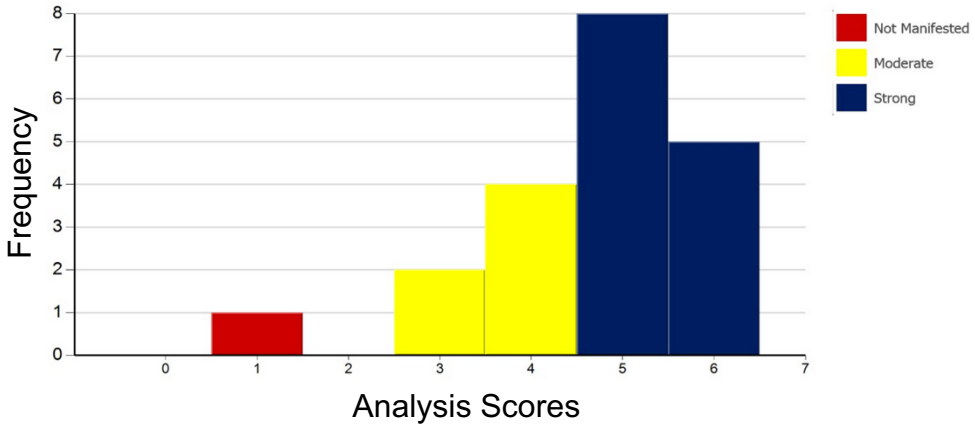

Figure 12. Histogram for the analysis score of the respiratory care faculty group. This histogram shows that 11 faculty members scored in the strong range, represented by blue bars. Six scored in the moderate range, represented by yellow bars, and only one scored in the not-manifested range, represented by the red bar.

Inference: The respiratory care faculty member group's mean score of inference was 3.7, with a standard deviation of 1.0. The median score was 4.0. The minimum score was 2 and the maximum score was 5. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 4. Using the recommended cut scores for categorical interpretation of the HSRT inference score provided in the HSRT user manual (2016), a mean inference score of 3.7 represents a moderate range. Figure 13 displays the inference score distribution of the respiratory care faculty group.

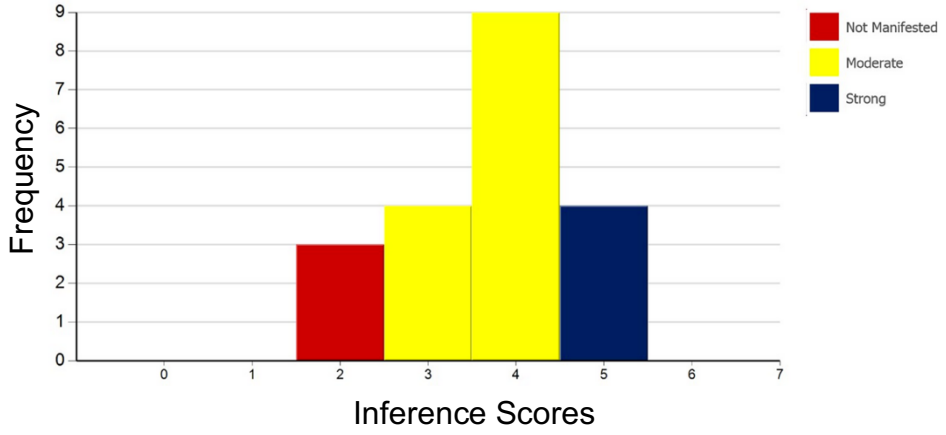

Figure 13. Histogram for the inference score of the respiratory care faculty group. This histogram shows that 13 faculty members scored in the moderate range, represented by yellow bars. Four scored in the strong range, represented by the blue bar, and three scored in the not-manifested range, represented by the red bar.

Evaluation: The respiratory care faculty member group's mean score of evaluation was 4.7, with a standard deviation of 1.0. The median score was 5.0. The minimum score was 1 and the maximum score was 6. The 25th percentile for this group (Quartile1) was 3 and the 75th percentile score (Quartile 3) was 6. Using the recommended cut scores for categorical interpretation of the HSRT evaluation score provided in the HSRT user manual (2016), a mean evaluation score of 4.7 is considered to be in the moderate to strong range. Figure 14 displays the evaluation score distribution of the respiratory care faculty group.

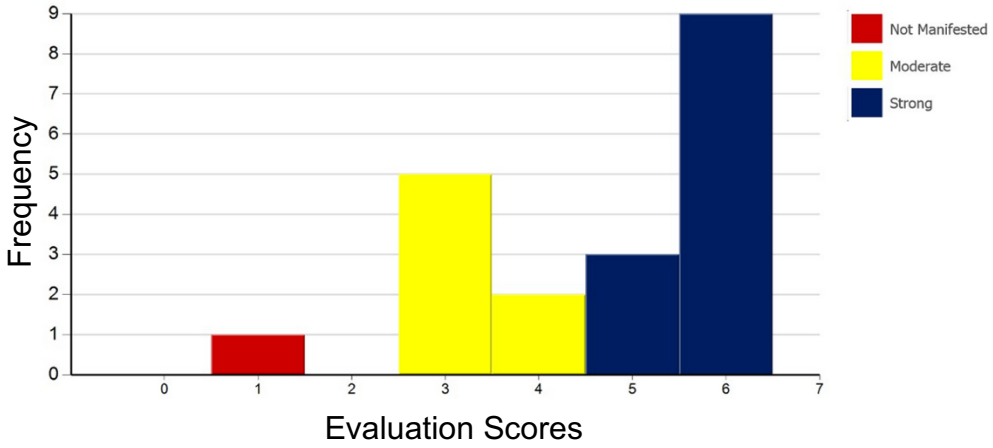

Figure 14. Histogram for the evaluation score of the respiratory care faculty group. This histogram shows that 12 faculty members scored in the strong range, represented by blue bars. Seven scored in the moderate range, represented by yellow bars, and one scored in the not-manifested range, represented by the red bar.

Comparing the HSRT Overall Critical Thinking Score of Respiratory Care Students and Faculty Members: Research Question 3

The independent samples *t*-test was used to determine whether respiratory care faculty members have stronger overall critical thinking skills than respiratory care students. The assumptions for the independent samples *t*-test were met by this particular study. Although participation in this study was voluntary, the researcher assumed that the respondents had the characteristics of a random sample because the survey was disseminated to all respiratory care programs in the United States and the assessment was completely confidential and anonymous. Based on the design of the study, the subjects in each group as well as between the two groups were independent of each other.

Moreover, the sample size for the two groups – 22 for the student group and 20 for the faculty group – were roughly equal. In terms of normality assumption, Table 3 shows the results for both the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. Since the sample size for both groups was less than 2,000, the Shapiro-Wilk test is appropriate for use (Razali & Yap, 2011). The Shapiro-Wilk test revealed that the normality assumption was met for both groups: For the student group $W(22) = 0.95$, $p = .291 > .05$ and for the faculty group $W(20) = 0.91$, $p = .066 > .05$. Based on Levene's test in Table 4, the homogeneity assumption was met; $F(1, 40) = 3.27$, $p = .078 > .05$.

Table 3
Normality Assumption of Overall Critical Thinking Score for Both Groups

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Overall Score	Student	.11	22	.200*	.95	22	.291
	Faculty	.18	20	.081	.91	20	.066

a=Lilliefors Significance Correction.
*= This is a lower bound of the true significance

Table 4
Homogeneity Assumption of Variances for the Overall Critical Thinking Score Between Groups

		Levene Statistic	df1	df2	Sig.
Overall Score	Based on Mean	3.27	1	40	.078
	Based on Median	2.97	1	40	.092
	Based on Median and with adjusted df	2.97	1	39.847	.093
	Based on trimmed mean	3.29	1	40	.077

Since all the assumptions of the independent samples *t*-test were met, the test was run. The first output is the groups' descriptive statistics. From this descriptive table (Table 5), the mean overall critical thinking score for the student group is 17.81, with a standard deviation of 4.19. The mean overall critical thinking score for the faculty group is 21.65, with a standard deviation of 5.41. Therefore, one can conclude that the mean overall critical thinking score for the faculty group sample (21.65) was higher than that for the student group sample (17.81).

Table 5
Descriptive Group Statistics of the Overall Critical Thinking Score for Student and Faculty Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Overall Score	Student	22	17.82	4.19	.89
	Faculty	20	21.65	5.41	1.21

The second output produced by SPSS is the independent samples *t*-test table (Table 6). Having established that the assumption of homogeneity of variances is met and from the line of equal variances assumed in Table 6, the results in this table show a statistically significant difference between the student and faculty groups regarding the overall critical thinking score: $t_{(40)}$ = 2.58, p =.014/2 = .007 < .05. (Since SPSS displays the p-value on a two-tailed basis, it was divided in half to be applicable to a one-tailed test since the hypothesis of this study is directional).

Table 6
Independent Samples t-test

		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
		F	Sig,	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Overall Score	Equal variances assumed	3.27	.078	2.58	40	.014	3.83	1.49	.83	6.84
	Equal variances not assumed			2.55	35.76	.015	3.83	1.50	.78	6.88

Based on this significant result in Table 6 and the fact that the mean overall score for the faculty sample (21.65) was higher than that for the student sample (17.81), one can conclude that respiratory care faculty members have

statistically significant stronger overall critical thinking skills than respiratory care students. Figure 15 displays the boxplot comparing the overall critical thinking scores on the HSRT between the respiratory care student and faculty member groups.

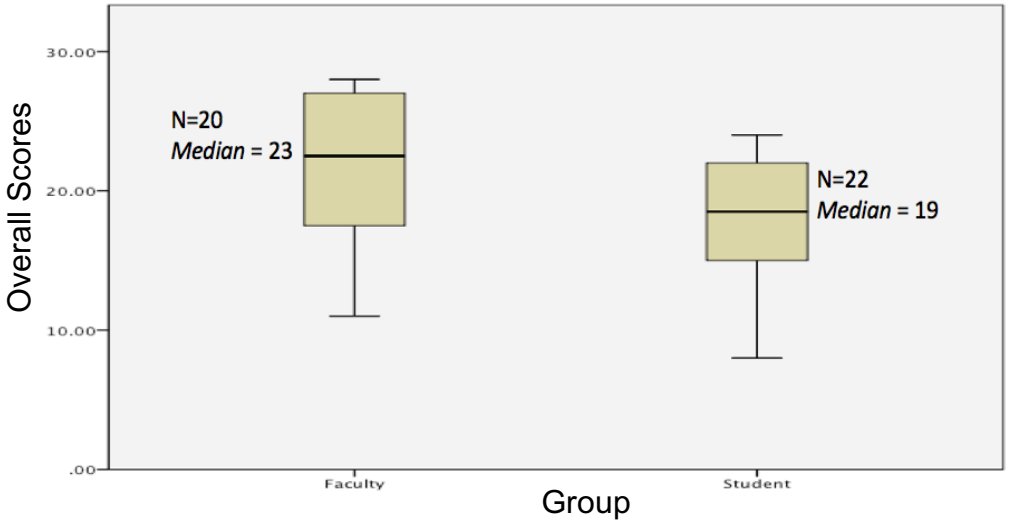

Figure 15. Boxplot of the HSRT overall critical thinking scores for the respiratory care student and respiratory care faculty member groups. This figure shows that the boxes overlap but not the medians, which indicates there is likely to be a difference between the respiratory care student and respiratory care faculty groups. If the difference exists, the faculty group will have stronger overall critical thinking skills than the student group since the median of the faculty group is higher than that of the student group.

Qualitative Results

The qualitative data were obtained from the responses of both respiratory care students and faculty members to the last three open-ended

questions embedded in the profile sheet of the survey: (1) How would you define critical thinking? (2) What role do you believe faculty play in fostering students' critical thinking? (3) What class assignments, activities, and experiences do you believe foster students' critical thinking (please, provide specific examples)?

The participants' responses to all three open-ended questions were typed. The primary investigator and another researcher coded the typed responses separately using a list of pre-established codes identified in the literature. If the response did not contain any of the pre-established themes, each of the two observers (primary investigator and another researcher) independently read the response and developed new codes based on what data seemed important. After coding the responses independently, Cohen's Kappa was calculated using SPSS to determine the inter-observer reliability to ensure that the agreement in coding was not due to chance (Viera & Garrett, 2005). The calculated Kappa for the codes of the first, second, and third open-ended questions' responses were 0.87, 0.85, and 0.86, respectively. These values indicate a satisfactory inter-observer reliability since they are greater than 0.70 (Viera & Garrett, 2005).

The first open-ended question asked, "How would you define critical thinking?" Twenty-five respiratory care students and 26 respiratory care faculty members answered this question. Upon reviewing the participants' responses, it was evident that the participants were aware of what critical thinking is. The

participants defined critical thinking with multiple descriptions and most of the descriptive terms emerged from the pre-established codes from the literature (Table 7).

Table 7
*Codes for the Responses to the Question, "*How would you define critical thinking?"

Code/Theme	Frequency of a Code/Theme	
	Student Group	Faculty Group
Problem solving	**9**	**8**
Logical reasoning	**4**	**5**
Decision making, judgment	**2**	**8**
Application	**5**	**3**
Analysis	**2**	**9**
Evaluation	**1**	**5**
Anticipate	**1**	**1**
Synthesize	**1**	**2**
Information gathering	**1**	**2**
Very complex, high-order of thinking	**1**	**1**
Quick thinking and responding	**3**	**1**
Creative thinking	**1**	**1**
Assessment, awareness, identify	1	9
Better care to patient	2	0

Clear thinking, wide thinking	1	1
Tactic/brainstorming	2	0

Note: Bolded codes are those that emerged from the literature. The total number of codes is not equal to the number of participant responses because some of the responses contained more than one code.

The second open-ended question asked, "What role do you believe faculty play in fostering students' critical thinking?" Twenty-five respiratory care students and 25 respiratory care faculty members answered this question. Based on a review of the participants' responses, it was evident that the participants emphasized the important role faculty play in fostering students' critical thinking. Participants believe that faculty can develop students' critical thinking by effectively acting as role models, guides, facilitators, and mentors and by employing active learning strategies such as case studies, simulations, and practicum (Table 8).

Table 8
Codes for the Responses to the Question, "What role do you believe faculty play in fostering students' critical thinking?"

Code/Theme	Frequency of a Code/Theme	
	Student Group	Faculty Group
Important role	**6**	**9**
Guide, help, facilitator, role model	**5**	**4**

Practice, train, apply in lab/clinic, hands on	**4**	**3**
Employing teaching strategies that foster critical thinking	**5**	**2**
Teaching/demonstrating critical thinking and its skills	**0**	**5**
Encourage, foster, challenge	**1**	**2**
Faculty experience	**2**	**0**
Safe environment	**0**	**3**
Opportunities	**0**	**2**
Builds/starts from scratch depending on student's cognitive level	**1**	**1**
Small class size	**1**	**0**
Giving knowledge needed	3	1
Critical thinking test question	2	1

Note: Bolded codes are those that emerged from the literature. The total number of codes is not equal to the number of participant responses because some of the responses contained more than one code.

The third open-ended question asked, "What class assignment, activities, or experiences do you believe foster students' critical thinking (please provide specific examples)?" Twenty-five respiratory care students and 25 respiratory care faculty members answered this question. Upon examining the responses, it was evident that the participants were able to report the educational

strategies that can promote students' critical thinking that were identified in the literature (Table 9).

Table 9
Codes for the Responses to the Question,"What class assignment, activities, and experiences, do you believe foster students' critical thinking?

Code/Theme	Frequency of a Code/Theme	
	Student Group	Faculty Group
Case scenario/case study	**5**	**14**
Simulation	**4**	**12**
Practicum (experience, clinical rotation, lab, hands on)	**13**	**8**
Discussion	**2**	**5**
Reflection in clinic/debriefing	**0**	**6**
Check off	**3**	**1**
Problem solving/PBL	**3**	**0**
Article critique/research paper	**1**	**4**
Socratic methods	**0**	**3**
Role play	**0**	**3**
Patient report/patient worksheet/SOAP	**2**	**2**
Clear communication	**0**	**1**
Synthesizing, authentic task, multiple intelligence activities	**0**	**3**
Worksheet/class assignment/homework	2	2

Test, short answer	1	1

Note: Bolded codes are those that emerged from the literature. The total number of codes is not equal to the number of participant responses because some of the responses contained more than one code.

Chapter V

DISCUSSION

With today's increased demand for evidenced-based patient-centered health care and the complexity surrounding the management of patient care, respiratory therapists are expected to, as part of the health care team, evaluate the patient's condition and recommend evidence-based clinical decisions for the development, administration, and evaluation of a patient plan of care specific to respiratory issues (Barnes et al., 2010). Doing so requires respiratory therapists to possess not only discipline-specific knowledge but also critical thinking skills that enable them to apply knowledge in clinical practice accurately and in a timely manner. Therefore, the purpose of this study was to explore the overall critical thinking skill levels of both respiratory care students and respiratory care faculty members who are expected to develop critical thinking skills of students, and to determine if respiratory care faculty members have stronger overall critical thinking skills than respiratory care students. Furthermore, this study investigated the perceptions of both respiratory care students and faculty members regarding what critical thinking is and how it can be developed.

Quantitative Findings

Critical Thinking Skill Level of Respiratory Care Students

In this study, the respiratory care student group exhibited moderate levels of critical thinking as measured by the mean overall critical thinking score

on the Health Sciences Reasoning Test (HSRT; *M* = 17.81). According to the user manual for the HSRT (2016), the score associated with a moderate level of overall critical thinking indicates the potential for skill-related challenges for people engaged in the problem solving and reflective decision making associated with learning or employee development.

Interestingly, the results of this study are only consistent with the findings of one of Clark's (2012) groups. The result observed in this study, in which the mean overall critical thinking score on the HSRT was in the moderate range for the respiratory care student group, was compared with the findings of Clark (2012) who compared the critical thinking skills of senior respiratory care students from an associate degree programs to that of students from a bachelor's degree program. In Clark's study, the mean overall critical thinking score for respiratory care students from associate degree programs was in the not-manifested range (*M* = 13.09 ± 4.0, n = 23), not the moderate range of critical thinking (*M* = 17.81 ± 4.19, n = 22), while the mean overall critical thinking score level of respiratory care students in bachelor degree programs was in the moderate range (*M* = 17.52 ± 6.14, n = 23). The findings of the bachelor degree program students are consistent with the finding of this study (*M* =17.81 ± 4.19, n = 22), regardless of program degree type.

The second study found in the literature was conducted by Colletti (2011) to study the impact of completing authentic tasks on the development of critical thinking for novice respiratory care students enrolled in programs that

offer associate degrees. As cited in Colletti (2011), authentic tasks consist of multifaceted learning activities (Herrington et al., 2006) that are designed to assess the learners' ability to make meaningful connections between the classroom and clinic environment (Andersson & Andersson, 2005). The study had two groups, control and intervention, and their critical thinking was measured two times, before and after the intervention. Since the measurement of critical thinking taken before the intervention is considered the baseline and this current study measured the critical thinking of respiratory care students at one point in time without implementing any intervention, only the measurements taken before implementing the intervention will be compared to the findings of this study. Colletti found that the mean overall critical thinking score was in the moderate range for both the treatment and control groups of associate degree respiratory care students (M = 18.1 ± 3.9, n = 24 and M = 17.1 ± 4.7, n = 27, respectively). This result is consistent with the findings of our study (M =17.81 ± 4.19, n = 22), regardless of program degree type.

Interestingly, in general the findings of this study supported the findings of two critical thinking studies the author found in the literature specific to respiratory care students (Clark, 2012; Colletti, 2011). The only finding not supported by this work is the level of critical thinking of associate's degree students in Clark study which was in the "not-manifested" but in the "moderate" level in this study. Clark suggested that students scored in the not-manifested due to that seven of them had their test interrupted when they took the online

HSRT and, since the test is timed to 50 minutes, this interruption may have influenced their score results on the HSRT as it does not allow them to complete the test within the specified time. Clark also suggested that the not-manifested score may have been due to some of the students in both associate and baccalaureate degree groups having a final exam directly before they took the HSRT, which may have influenced their level of critical thinking scores, given that a not-manifested level according to the HSRT manual means the test-takers may put insufficient effort into taking the test, suffer cognitive fatigue during taking the test, or have reading or language comprehension issues. Clearly, these reasons might help to explain the inconsistency between the critical thinking level of respiratory care students of this study and those Clark associate's degree respiratory care students. In addition to this inconsistency, the small sample size in our study and that of Clark as also Colletti may account for differences in the findings and thus support the need for additional research with a large sample size.

Critical Thinking Skill Level of Respiratory Care Faculty Members

In this study, respiratory care faculty members exhibited a strong level in regard to the mean overall critical thinking score on the HSRT (*M* = 21.65). According to the user manual for the HSRT (2016), a strong level on the overall critical thinking score indicates the potential for academic success and career development.

In examining the literature, the researcher was not able to find any studies that have measured the critical thinking level of respiratory care faculty members regardless of the type of critical thinking measurement tool used. Therefore, the findings concerning the critical thinking of respiratory care faculty members will be compared to that of nursing faculty as nursing is close health care collaborator with the respiratory care profession. In nursing, two studies have assessed the level of critical thinking of nursing faculty, both used the California Critical Thinking Skills Test (CCTST) in an untimed format (Blondy, 2011; Zygmont & Schaefer, 2006). It is important to note that the 33 questions on the HSRT, the tool used in this study, were derived from the CCTST, which has 34 questions. In addition, both tools (HSRT and CCTST) were developed by the same authors (Facione and Facione) and report the same six distinct scores: induction, deduction, analysis, inference, evaluation, and overall score. The main difference between the tools is that the questions in the CCTST are set in everyday scenarios, whereas the questions in the HSRT are set in health care scenarios, making the HSRT more appropriate to measure critical thinking skills of health care students and professionals. The first nursing study was conducted by Blondy (2011) who found a mean overall critical thinking score for nursing faculty of $M = 22.12 \pm 3.64$, n = 49. The mean score is considered in the strong range based on the CCTST manual, making it consistent with the findings of this study ($M = 21.65 \pm 5.41$, n = 20). Similarly, the second study, conducted by the Zygmont and Schaefer (2006) found a mean overall critical

thinking score for nursing faculty of *M* =19.14 ± 6.76, n = 37. This mean score is considered in the strong range based on the CCTST manual, making it also consistent with the findings of this study (*M* = 21.65 ± 5.41, n = 20).

Based upon our review of the literature, critical thinking levels of respiratory care faculty are consistent with findings observed in nursing faculty (Blondy 2011; Zygmont & Schaefer, 2006). While one might not be surprised by this finding, it was imperative that we measured critical thinking levels of respiratory care faculty for several reasons. First, since no study, to our knowledge, has measured their level of critical thinking, it generated new information that could be used in the academy. Second, while both nurses and respiratory therapists are health care providers who work together to develop patient-centered plans of care, their scope of practice are different and their skill sets and roles on the team are different and require different levels of critical thinking potentially. Thus, inferring that they would possess the same critical thinking skills would limit our knowledge base.

Comparing Critical Thinking Skills in Respiratory Care Students and Faculty Groups

While educational programs hope that faculty possess stronger critical thinking than their students and that given their stronger critical thinking skills they can develop students' critical thinking skills, this study, to our knowledge, was the first in respiratory care to assess whether these assumptions hold true. In this study, respiratory care faculty members did present with significantly stronger overall critical thinking skills than respiratory care students (*p* =.007)

thus supporting the first assumption. Laying this foundation, researchers can now begin to assess whether because of faculty increased critical thinking they can develop critical thinking in their students specifically in the respiratory care profession.

While this assumption had not been previously supported in respiratory care, Blondy (2011) found that the mean overall critical thinking of nursing faculty (22.12) was higher than the aggregate norm reference data of the generic undergraduate students (16.04) provided by the Insight Assessment. Zygmont and Schaefer (2006) also found that the mean overall critical thinking of nursing faculty (19.14) was higher than the four-year college students' aggregate norm reference data (16.8) provided by the Insight Assessment, making it consistent with the finding of this study. In addition, Zygmont and Schaefer found that the mean overall score for critical thinking skills of nursing faculty (19.14) was similar to the aggregate norm reference data of graduate nursing students (19.01). The authors justified this result by stating that critical thinking is a process that begins in undergraduate studies and is developed with time, experience, and education. Also, the similarity in their critical thinking may be explained by identifying graduate nursing students as a self-selected group. However, this study did not compare the critical thinking of respiratory care faculty members to that of graduate respiratory care students since doing so was beyond the scope of study and few students were in the category of graduate, making the comparison useless. Instead, the critical thinking of

respiratory care faculty members was compared to that of all respiratory care students regardless of their educational degree. As with respiratory care evidence is not available to substantiate the second assumption that if faculty possess greater critical thinking then they can develop greater critical thinking in their students. This observation opens an additional line of inquire for future researchers in the health science.

Qualitative Findings

While the quantitative findings provided clarity as to the level of critical thinking in respiratory care students and faculty, the qualitative findings helped to provide further insight. The results of the qualitative findings for the question "How would you define critical thinking?" revealed that respiratory care students and faculty preferred multiple descriptions of critical thinking rather than one description. This finding is not surprising when considering that critical thinking is a complex process involving a variety of skills. Furthermore, this disagreement in defining critical thinking is consistent with the results of other studies in health care that have asked faculty to define critical thinking (Krupat et al., 2011; Rowles, Morgan, Burns, & Merchant, 2013). Based on the responses of respiratory care students and faculty, we also found that most of the reported descriptions of critical thinking were identified in the literature, such as problem solving, logical reasoning, and decision making. This finding indicates that both respiratory care students and faculty members understand the concept of critical thinking despite the term having more than one definition

in the literature. This awareness of what critical thinking is reflects on the preparation and readiness of respiratory care students to learn critical thinking and on the preparation and readiness of respiratory care faculty to promote critical thinking in their students.

The results of the qualitative findings for the question "What role do you believe faculty play in fostering students' critical thinking?" revealed that both respiratory care students and faculty emphasized the important role faculty play in promoting students' critical thinking by acting as facilitators, guides, and role models and by employing active learning strategies such as clinical simulation and case studies. These findings support the expectation in the literature that faculty are responsible for promoting students' critical thinking (Adams, 1995; Loving & Wilson, 2000; Robbins, 1988; Wangensteen et al., 2010) and also support the findings of Hulse's (2009) qualitative, single-case study which found that the expert respiratory care faculty believe that students' critical thinking can be developed by motivating students to learn by doing (i.e., active learning strategies).

The results for the question "What class assignments, activities, and experiences, do you believe foster students' critical thinking?" revealed that both respiratory care students and faculty reported various active learning strategies that they think foster students' critical thinking. Most of the reported strategies are found in the published literature, including clinical simulation, case studies, problem-based learning, and reflection (Goodstone et al., 2013;

Kaddoura, 2011; Kong, Qin, Zhou, Mou, & Gao, 2014; Kowalczyk, 2011; Raterink, 2016). Hulse (2009) who studied expert respiratory care faculty found that they also believed that applying knowledge, problem solving, discourse, and evidence-based practice, to name few, are active learning strategies that should be used by faculty to promote students' critical thinking. The responses of respiratory care students and faculty members in the present study demonstrate their awareness of how critical thinking can be incorporated and facilitated in classroom and clinical settings and thus offer insight to educators.

Integrating Quantitative and Qualitative Findings

Integrating the quantitative and qualitative findings supports the conceptual framework of this study (Figure 16). The conceptual framework shows that critical thinking is composed of logical reasoning, problem solving, and reflection and these principles emerged in the responses of respiratory care students and faculty members to the first open-ended question, "How would you define critical thinking?"

This conceptual framework also shows that respiratory care faculty members should possess higher critical thinking skills than respiratory care students to promote students' critical thinking; this is represented by having the circle of faculty higher than the circle of respiratory care students, as shown in Figure 16. This claim is supported by the results of this study, which found that respiratory care faculty members exhibited a strong level in the mean overall score on the HSRT whereas respiratory care students exhibited a moderate

level in the mean overall score. Furthermore, the independent samples *t*-test of this study showed that respiratory care faculty members have significantly stronger overall critical thinking skills than respiratory care students ($t_{(40)} = 2.58$, $p = .007$).

The responses of respiratory care students and faculty members to the second open-ended question, "What role do you believe faculty play in fostering students' critical thinking?" revealed that faculty play an important role in promoting students' critical thinking by effectively acting as role models, mentors, guides, and facilitators. These findings support the conceptual framework of this study, represented by the check sign in front of terms "faculty", "role model," and "mentoring" (Figure 16). In addition, the responses to the aforementioned question suggests that faculty can foster students' critical thinking by employing active learning strategies. Since this is a new theme that has emerged from the responses of respiratory care students and faculty members in this study, an asterisk was placed near the phrase "active learning strategies" to indicate the emergence of a new theme (Figure 16). Responses of both respiratory care students and faculty members to the third open-ended question, "What class assignments, activities, and experiences do you believe foster students' critical thinking?", included many examples of active learning strategies that are also found in the published literature, including clinical simulation, case studies, problem-based learning, and

reflection (Goodstone et al., 2013; Kong et al., 2014; Kowalczyk, 2011; Raterink, 2016).

The other new theme that emerged from the responses of the second open-ended question, "What role do you believe faculty play in fostering students' critical thinking?," indicated that not only do faculty members play an important role in developing students' critical thinking but educational programs also play a role. Therefore, an asterisk was placed near the phrase "program characteristics" to indicate the emergence of a new theme (Figure 16). Educational programs can promote students' critical thinking by providing a safe educational environment and having a small class size so students have more opportunity to engage in critical thinking activities. The expert respiratory care faculty studied by Hulse (2009) also believed that programs' characteristics can help in fostering students' critical thinking and one of these characteristics is the faculty-to-student ratio. Furthermore, Mishoe (1994) explored the organizational factors that affect the critical thinking of respiratory therapists: (1) involvement and level of support from the medical director, (2) departmental administration and climate of the respiratory care department, (3) scope of practice, duties, and responsibilities, and, (4) role delineations between registered respiratory therapists and certified respiratory therapy technicians (p. 204). Therefore, the literature argues that the characteristics of a program or an organization play a role in developing the critical thinking of respiratory care students and therapists.

Although not expected when asked, “What role do you believe faculty play in fostering students’ critical thinking”, one of the students reported, “I would say an important role, however, the student also needs to have basic critical thinking skills. The faculty should then build off of this skill, not build it from the ground up,” and one of faculty reported, “very important role, but most often start from scratch as fundamental analytical skills were not [present].” Based on the two unexpected responses, it can be inferred that both faculty and students perceive students should actively participate in the development of their critical thinking skills and that participating in case studies, discussions, and practicum may assist them. Therefore, an asterisk was placed near the phrase “student critical thinking” to indicate the emergence of a new theme (Figure 16).

The findings from this study also support the aims outlined in the American Association for Respiratory Care (AARC) project titled, 2015 and Beyond which supports opportunities to investigate how respiratory care programs and faculty can support respiratory care students’ journey to become strong critical thinkers. AARC has highlighted the importance of respiratory care students possessing advanced critical thinking to meet with the challenges they will face in practice, especially with the growing demands in health care in the United States. AARC stated that “graduate therapists need to begin RT [respiratory therapy] practice with *excellent critical thinking skills*, to deal with complex technology and protocols” (Barnes et al., 2010, p. 607). It further

stated, “A *high level of critical thinking skills* and the ability to apply the appropriate best-practice protocols was identified by both AARC conferences as a request for treatment of critically ill patients in ICUs [intensive care units] and emergency departments” (Barnes et al., 2010, p. 608). These statements support the investigation of how respiratory care students can develop their critical thinking and reach the advanced level recommended by the AARC. Given that respiratory care faculty possess strong critical thinking skills and some scored in the superior range, this led us to expect that experience and education can develop critical thinking. This expectation supports the recommendation of the AARC task force, which in 2010 suggested upgrading the minimum educational degree needed to practice as a respiratory therapist from associate to bachelor degree (Barnes et al., 2011). This recommendation was approved by the Commission on Accreditation of Respiratory Care (CoARC) on January 28, 2016, and will be put into an action by 2018 (CoARC, 2016a). After January 1, 2018, no accreditation will be offered for any respiratory care program awarding associate degrees (CoARC, 2016a). Currently, 85% of respiratory care programs offer an associate degree, 14% a baccalaureate degree, and 1% a master’s degree (CoARC, 2016b). In addition to the educational degree, most of the participants of the third AARC conference agreed on the need to upgrade the minimum entry credentialing exam for respiratory therapist from successfully passing the certified respiratory therapist (CRT) exam to successfully passing the advanced-level examination,

registered respiratory therapist, as the certified respiratory therapist exam measures the technical abilities and not the critical thinking of test-takers (Barnes et al., 2011). However, this recommendation has not yet been approved by the CoARC. The goal of these recommendations is to ensure that respiratory therapists have the level of knowledge and critical thinking skills needed to demonstrate competence in the respiratory care scope of practice projected in the document titled, 2015 and Beyond (Barnes et al., 2011).

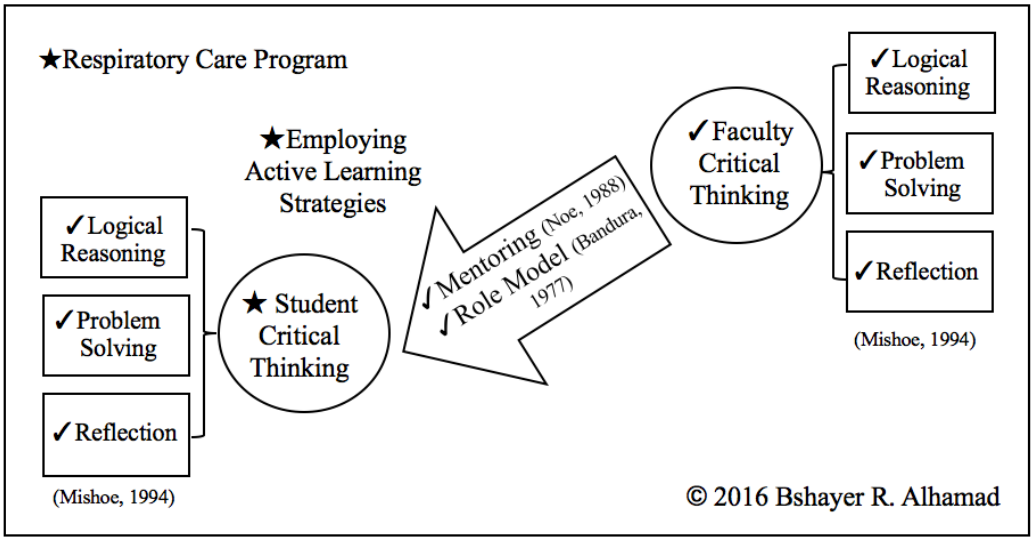

Figure 16. Integrated quantitative and qualitative findings supporting the conceptual framework of the study. This conceptual framework illustrates that faculty, students, and programs all have important roles in promoting students' critical thinking.
✓= existing theme, supported the study conceptual framework
★= new theme, added to the study conceptual framework

Potential Implications of the Study Results

This study provided a valuable contribution to the existing body of literature concerning critical thinking in the profession of respiratory care since it lays the groundwork for understanding critical thinking skill levels of both respiratory care students and faculty members. Limited studies in the literature have assessed the critical thinking skills of respiratory care students with most of them using general critical thinking measurement tools which may not reflect the type of critical thinking needed by respiratory care students as they practice clinically. The current study along with only two other studies in respiratory care (Clark, 2012; Colletti, 2011) have used the HSRT, a more appropriate tool to assess the critical thinking of health care students and professionals, to measure the critical thinking of respiratory care students. Therefore, the results observed in this study, in which respiratory care students exhibited a moderate level in the mean overall critical thinking score on the HSRT adds to the limited studies in the literature. Additionally, to our knowledge, the current study is the first in respiratory care that explored critical thinking skills of respiratory care faculty and supports the assumption that they have strong critical thinking skills. Understanding respiratory care faculty critical thinking may provide insightful information to faculty about their critical thinking skills which may potentially aide them as they seek to promote critical thinking of respiratory care students. This finding open an opportunity to take a further step to assess whether this stronger level can help respiratory care faculty develop critical thinking of their

students. In addition to understanding the level of critical thinking in respiratory care students and faculty members, this study investigated their perceptions regarding the concept of critical thinking and how it can be developed. From their perceptions, in general, the themes identified in the literature for defining critical thinking where supported and that they believed that faculty should play an important role in fostering students' critical thinking. In addition, they thought that active learning student-centered educational strategies foster students' critical thinking. This finding provides insight into the potential preparation of respiratory care students and faculty as educators seek to develop their critical thinking skills needed for clinical practice. Thus, these findings about the level of critical thinking and the perceptions of both respiratory care students and faculty members can provide respiratory care educational programs with insightful information needed to further develop an educational environment that seeks to develop and advance students' critical thinking. Furthermore, information obtained from this study may help in establishing an empirical basis for future research to investigate how respiratory care educational programs and faculty can further develop students' critical thinking into the advanced level, recommended by the AARC.

Future Research Direction

While this study measured the critical thinking skills of respiratory care students and found their level in the moderate range, it would be interesting to identify the key points of transition in critical thinking during their educational

and professional journey. Also, since this study identified that respiratory care faculty exhibited strong critical thinking levels and that their critical thinking was stronger than respiratory care students, researchers can now further assess whether this strong level can help respiratory care faculty develop critical thinking in their students. Given the need for health care professionals to practice patient-centered evidenced-based care collaboratively in a team, future studies can assess the critical thinking skills of diverse health care students and professionals and compare their critical thinking skills to those of respiratory care students and practitioners as they are collaborative partners in the inter-professional health care team who seeks to deliver patient-centered care.

Finally, researchers who are interested in replicating this study should explore alternate modes of securing participation. Because email and an online version of the HSRT were utilized to recruit participants in this study, it was easy for them not to respond to the study request. Therefore, in-person contact and a paper version of the HSRT at local colleges/universities might result in a larger sample size for several reasons. First, in-person contact is a more personalized form of contact than email and allows the researcher to explain the importance of conducting this assessment to the candidate, which can act as a motivation for the candidate to participate and provide his or her best effort in completing the assessment. Second, in-person contact allows the researcher to provide an incentive to participate, such as offering extra credit

or replacing an assignment with the HSRT. Incentives act as a motivator for candidates to complete the test, which may result in more accurate results in regard to the critical thinking of participants. In addition, using a paper-and-pencil version of the HSRT can avoid technical requirements or issues associated with the online version, such as requiring Java software installation.

Clinical Recommendations

Producing critical thinker respiratory care students with advanced critical thinking skills is likely to result in competent respiratory therapists who deliver safe and effective patient-centered care in cooperation with an inter-professional health care team and who equipped to face the challenges of today's fast-paced and technologically advanced respiratory care practice. Therefore, it is imperative that respiratory care programs should continue to develop the critical thinking of both respiratory care students and faculty. Doing so will enable both groups to meet the growing scope of practice of respiratory therapists resulting from the increased demands in health care. Respiratory care educational programs can develop critical thinking by providing a supportive educational environment which can provide opportunities for students to practice how to think critically and by offering professional development opportunities for faculty to ensure that they feel comfortable demonstrating and transferring how to think critically to their students. In addition, respiratory care faculty must understand and embrace their important role in promoting students' critical thinking by employing active learning

strategies and by effectively acting as role models, mentors, guides, and facilitators. Finally, respiratory care students should participate in developing their critical thinking by assessing their critical thinking level on a continuous basis and being willing to engage in the active learning strategies employed by their faculty in the classroom and clinical settings.

Limitations

As with any study, this study has limitations. The generalizability of the results is limited due to the small sample size and non-probability sampling. The study is also limited in its ability to recruit candidates to participate. Although the invitation email and multiple reminders were sent to all directors of accredited respiratory care programs in the United States, only a small number of respiratory care students and faculty members elected to participate. Due to the low response, the primary investigator sent a direct invitation email to the respiratory care faculty identified in the school's website. Additionally, these faculty were asked to forward the solicitation letter directly to their students, thus using a snow-ball sampling method. With all this effort, only 26 respiratory care students and 27 respiratory care faculty members chose to take part in the study, with only 22 students and 20 faculty members ultimately completing the HSRT and included in the analysis. The low response for this study may be due to the impersonal nature of recruitment via email, which makes it easy for participants to avoid responding. This study selected email as a recruitment method to make it more feasible and convenient to reach out

to potential study participants across the United States. The hope was that this would result in a better representation of the study population and thus more generalizability of the study findings. Other reasons that may have led to the low response rate are the time needed to complete the HSRT (within 50 minutes) and the technical issues associated with the online HSRT. An updated version of Java software was needed to access the HSRT and thus if participants did not have that software, they would have had to download it. If they tried to access the HSRT from their school computers, they may have found that their school restricts users from downloading any software and thus they could not access the HSRT. Another limitation is that the HSRT measures only the skills of critical thinking; however, critical thinking involves skills, traits, and organizational factors. As with any self-administered test, it was unknown whether participants took the test seriously and in a quite environment without distractions; illegitimate efforts could underestimate the scores for the participants' critical thinking.

Conclusion

Fostering critical thinking in respiratory care students is imperative in respiratory care education since critical thinking is the main proficiency needed to function as a competent respiratory therapist. In this study, both respiratory care students and faculty members demonstrated an ability to think critically; respiratory care students exhibited a moderate level in the mean overall critical thinking score on the HSRT, whereas respiratory care faculty members

exhibited a strong level. In addition, this study supported the assumption that respiratory care faculty have statistically stronger critical thinking skills than respiratory care students. Furthermore, this study found that most of the respiratory care students and faculty members who participated in the study had both knowledge and awareness of the definition of critical thinking, the role that faculty play in fostering students' critical thinking, and the educational strategies that promote critical thinking. Based on the findings of this study, the road to developing strong critical thinking skills in respiratory care students is partially paved; therefore, it is imperative to investigate how respiratory care programs and faculty can continue to develop the critical thinking of respiratory care students to an advanced level. This advanced level of critical thinking is needed to ensure that respiratory care students are sufficiently prepared to be competent respiratory therapists who can meet the challenges they face in practice, especially with the growing demands in health care which ultimately might help to make the delivered patient care safer and more effective.

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Appendix A

Seton Hall University Institutional Review Board Approval Letter

OFFICE OF INSTITUTIONAL REVIEW BOARD
SETON HALL UNIVERSITY

March 2, 2016

Bshayer Alhamad
5 Manor Drive, Apt. 3M
Newark, NJ 07106

Dear Ms. Alhamad,

The Seton Hall University Institutional Review Board has reviewed the information you have submitted addressing the concerns for your proposal entitled "Exploring the Critical Thinking Skills of Respiratory Care Students and Faculty." Your research protocol is hereby accepted as revised and is categorized as exempt.

Please note that, where applicable, subjects must sign and must be given a copy of the Seton Hall University current stamped Letter of Solicitation or Consent Form before the subjects' participation. All data, as well as the investigator's copies of the signed Consent Forms, must be retained by the principal investigator for a period of at least three years following the termination of the project.

Should you wish to make changes to the IRB approved procedures, the following materials must be submitted for IRB review and be approved by the IRB prior to being instituted:

- Description of proposed revisions;
- *If applicable*, any new or revised materials, such as recruitment fliers, letters to subjects, or consent documents; and
- *If applicable*, updated letters of approval from cooperating institutions and IRBs.

At the present time, there is no need for further action on your part with the IRB.

In harmony with federal regulations, none of the investigators or research staff involved in the study took part in the final decision.

Sincerely,

Mary F. Ruzicka, Ph.D.

Mary F. Ruzicka, Ph.D.
Professor
Director, Institutional Review Board

Appendix B

Solicitation Letter and Informed Consent for Respiratory Care Students

LETTER OF SOLICITATION AND INFORMED CONSENT

Study Title: Exploring the Critical Thinking Skills of Respiratory Care Students and Faculty

Dear Respiratory Care Student,

Affiliation:
My name is Bshayer Alhamad. I am a doctoral student at Seton Hall University in the Department of Interprofessional Health Sciences and Health Administration. I am conducting this study in partial fulfillment of my dissertation requirement for the PhD in Health Sciences degree.

Purpose:
You are invited to participate in this study because you are respiratory care student currently studying in an accredited respiratory care program in the US. Studies have shown that critical thinking is central to the function of the respiratory care profession. Therefore, the purpose of this study is to understand the critical thinking skill levels of respiratory care students and faculty members.

Procedure:
You will be asked to complete 1 questionnaire, which contains the following two sections:

1. Health Science Reasoning Test: The purpose of this standardized test is to assess one's critical thinking skills.
2. Demographic data sheet: This section facilitates the collection of demographic information including but not limited to gender, age, and educational degree. This sheet will also ask participants to respond to 3 open-ended questions regarding critical thinking.

It is important that you complete each section in its entirely. It should not take you more than 60 minutes to complete.

Voluntary Participation:
Your participation in this study is voluntary. You may decide at any time not to participate or stop taking the survey by clicking the X on the web browser without penalty.

Anonymity:
You will not be asked to provide your name if you agree to participate in this study. You will not be identified by name or description in any reports or publications about this study.

Privacy and Confidentiality:
Protection and confidentiality will be maintained throughout the duration of the research project. No personal identifying information will be collected from participants. However, upon completion of the study, all data will be stored on a USB memory key with access to the file protected by the use of a password known only by the principal researcher. The memory key will remain in a secured filling cabinet for three years and then destroyed.

Risk:
There is no foreseeable risk factor or discomfort anticipated by participating in this study. However, please be aware that as with any online survey the remote possibility exists that an account can be hacked.

Benefits of participation:
Once you complete this survey, you will immediately receive a report on your critical thinking skill level. Your participation will also contribute to the knowledge of critical thinking within the respiratory care profession.

Compensation:
There will be no monetary or any kind of compensation for your participation in this study.

Ways to Participate:
To participate in this study, please access the following link and follow the instructions below provided by Insight Assessment to the Health Sciences Reasoning Test.

Informed Consent: I fully understand that accessing and completing the survey through the link listed below conveys my informed consent to participate in this study.

Instruction: This entire process should take no more than 60 minutes. Please be sure that you have allowed yourself plenty of time and, if using a laptop, have plenty of battery life to complete the test.

1. Begin by opening Internet Explorer or Firefox and going to www.insightassessment.com (browsers other than Internet Explorer and Firefox may work but are not officially supported by Insight Assessment).

2. Please read the reminder of these instructions before moving on. Once the test-taker interface has opened, it can be minimized so that you can refer back to these instructions with your questions.
3. Next, locate and select the *Yellow "Test Taker Login"* button at the top right of the home page. 

4. Once you have reached the dark Blue Login Screen, please enter the following login ID and password:

Login	***Password***
RTSTUDENT	RTSTUDENT

Note: If you have any problems with the login, you can check the configuration of your computer by using the yellow "click here" diagnostic on this login screen.

5. Read the warning screen and select "Continue." Our system will then check to make sure that your computer has an updated version of Java. **Please be patient and follow any instructions that appear allowing the system to either "open" or "run" the program**. If you have trouble here please follow this link to run our system verification tool on your computer http://members.insightassessment.com/Verify?bhcp=1
6. When your personal profile page opens: Respond to **ALL** of the items on this screen and then click "Save Profile." **You can click "Continue" to move to the assessment itself only after your profile is saved.**
   Important Note: You may need to scroll up or down or left or right to see the questions and answer choices or the "save" button.
7. Select **Health Sciences Reasoning Test (HSRT)** using the pull-down menu, then click "Continue."
8. Accept the User Agreement Terms.
9. Read the test instructions and continue to take the exam.
   Important Note: You may need to scroll up or down to read the questions and answer choices or to see the navigational arrows to move from question to question. Be sure to maximize your browser window so that the automatic scroll bar(s) will appear.
10. You can see the time remaining in the timer displayed on the top right of your screen.
11. After completing all of the questions, **submit your responses by clicking "Done with test/survey" – at the top left of your screen.**
12. Once you have submitted your results, you can print your results report if you would like to do so.
13. Click the "Log Out" button in the top right corner of the screen.

Once you have completed your survey participation, please do not take the survey again.

Contact Information:
If you have any questions at any time concerning this study, please contact the primary researcher, Bshayer Alhamad at (973)275-2076 or via her email bshayer.alhamad@student.shu.edu or you can reach Dr. Genevieve Pinto Zipp, Dissertation chair for Ms. Alhamad at (973) 275-2457 or via her email Genevieve.zipp@shu.edu in the Department of Interprofessional Health Sciences and Health Administration in the Seton Hall University School of Health and Medical Sciences. For questions concerning the rights of research participants you can contact Dr. Mary Ruzicka, Director of the Institutional Review Board, in the office of IRB at Seton Hall University at (973) 313-6314 or via email irb@shu.edu

Thank you for considering participating and contributing to my research. Your time and consideration are greatly appreciated.

Appendix C

Solicitation Letter and Informed Consent for Respiratory Care Faculty

LETTER OF SOLICITATION AND INFORMED CONSENT

Study Title: Exploring the Critical Thinking Skills of Respiratory Care Students and Faculty

Dear Respiratory Care Faculty,

Affiliation:
My name is Bshayer Alhamad. I am a doctoral student at Seton Hall University in the Department of Interprofessional Health Sciences and Health Administration. I am conducting this study in partial fulfillment of my dissertation requirement for the PhD in Health Sciences degree.

Purpose:
You are invited to participate in this study because you are respiratory care faculty currently teaching in an accredited respiratory care program in the US. Studies have shown that critical thinking is central to the function of the respiratory care profession. Therefore, the purpose of this study is to understand the critical thinking skill levels of respiratory care faculty members and students.

Procedure:
You will be asked to complete 1 questionnaire, which contains the following two sections:

1. Health Science Reasoning Test: The purpose of this standardized test is to assess one's critical thinking skills.
2. Demographic data sheet: This section facilitates the collection of demographic information including but not limited to gender, age, and educational degree. This sheet will also ask participants to respond to 3 open-ended questions regarding critical thinking.

It is important that you complete each section in its entirely. It should not take you more than 60 minutes to complete.

Voluntary Participation:
Your participation in this study is voluntary. You may decide at any time not to participate or stop taking the survey by clicking the X on the web browser without penalty.

Anonymity:
You will not be asked to provide your name if you agree to participate in this study. You will not be identified by name or description in any reports or publications about this study.

Privacy and Confidentiality:
Protection and confidentiality will be maintained throughout the duration of the research project. No personal identifying information will be collected from participants. However, upon completion of the study, all data will be stored on a USB memory key with access to the file protected by the use of a password known only by the principal researcher. The memory key will remain in a secured filling cabinet for three years and then destroyed.

Risk:
There is no foreseeable risk factor or discomfort anticipated by participating in this study. However, please be aware that as with any online survey the remote possibility exists that an account can be hacked.

Benefits of participation:
Once you complete this survey, you will immediately receive a report on your critical thinking skill level. Your participation will also contribute to the knowledge of critical thinking within the respiratory care profession.

Compensation:
There will be no monetary or any kind of compensation for your participation in this study.

Ways to Participate:
To participate in this study, please access the following link and follow the instructions below provided by Insight Assessment to the Health Sciences Reasoning Test.

Informed Consent: I fully understand that accessing and completing the survey through the link listed below conveys my informed consent to participate in this study.

Instruction: This entire process should take no more than 60 minutes. Please be sure that you have allowed yourself plenty of time. if using a laptop, have plenty of battery life to complete the test.

1. Begin by opening Internet Explorer or Firefox and going to www.insightassessment.com (browsers other than Internet Explorer and Firefox may work but are not officially supported by Insight Assessment).

2. Please read the reminder of these instructions before moving on. Once the test-taker interface has opened, it can be minimized so that you can refer back to these instructions with your questions.
3. Next, locate and select the *Yellow "Test Taker Login"* button at the top right of the home page. 

4. Once you have reached the dark Blue Login Screen, please enter the following login ID and password:

Login	***Password***
RTFACULTY	RTFACULTY

Note: If you have any problems with the login, you can check the configuration of your computer by using the yellow "click here" diagnostic on this login screen.

5. Read the warning screen and select "Continue." Our system will then check to make sure that your computer has an updated version of Java. **Please be patient and follow any instructions that appear allowing the system to either "open" or "run" the program**. If you have trouble here please follow this link to run our system verification tool on your computer http://members.insightassessment.com/Verify?bhcp=1
6. When your personal profile page opens: Respond to **ALL** of the items on this screen and then click "Save Profile." **You can click "Continue" to move to the assessment itself only after your profile is saved.**
   Important Note: You may need to scroll up or down or left or right to see the questions and answer choices or the "save" button.
7. Select **Health Sciences Reasoning Test (HSRT)** using the pull-down menu, then click "Continue."
8. Accept the User Agreement Terms.
9. Read the test instructions and continue to take the exam.
   Important Note: You may need to scroll up or down to read the questions and answer choices or to see the navigational arrows to move from question to question. Be sure to maximize your browser window so that the automatic scroll bar(s) will appear.
10. You can see the time remaining in the timer displayed on the top right of your screen.
11. After completing all of the questions, **submit your responses by clicking "Done with test/survey" – at the top left of your screen.**
12. Once you have submitted your results, you can print your results report if you would like to do so.
13. Click the "Log Out" button in the top right corner of the screen.

Once you have completed your survey participation, please do not take the survey again.

Contact Information:
If you have any questions at any time concerning this study, please contact the primary researcher, Bshayer Alhamad at (973)275-2076 or via her email bshayer.alhamad@student.shu.edu or you can reach Dr. Genevieve Pinto Zipp, Dissertation chair for Ms. Alhamad at (973) 275-2457 or via her email Genevieve.zipp@shu.edu in the Department of Interprofessional Health Sciences and Health Administration in the Seton Hall University School of Health and Medical Sciences. For questions concerning the rights of research participants you can contact Dr. Mary Ruzicka, Director of the Institutional Review Board, in the office of IRB at Seton Hall University at (973) 313-6314 or via email irb@shu.edu

Thank you for considering participating and contributing to my research. Your time and consideration are greatly appreciated.

Appendix D

Profile Sheet for Respiratory Care Students

1. What degree will you earn upon completing your current respiratory care program?
   - Associate degree
   - Bachelor degree
   - Master degree

2. How many credits have you earned in the current respiratory care program to date?
   Less than 30
   - 30-59
   - 60-89
   - 90-119
   - 120 and more

3. How many clinical courses/rotations/practicum have you completed within the current respiratory care program?
   - 1
   - 2
   - 3
   - 4
   - more than 4

4. How often do you meet with your Faculty Advisor?
   - Never
   - Rare
   - Sometimes
   - Often
   - Always

5. Do you consider your respiratory care faculty to be role models?
   - Yes, all of them
   - Yes, some of them
   - No, none of them

6. How many years have you been working as a respiratory therapist?
   - Not applicable
   - Less than 1 year
   - 1-5 years
   - 6-10 years
   - 11-15 years

- 16-20 years
- more than 20 years

7. Does your current program teach you critical thinking?
   - Yes, we have a critical thinking course
   - Yes, critical thinking is integrated in our courses
   - Yes, we have a critical thinking course AND it is integrated in our courses
   - No
   - Not sure

8. How would you define “critical thinking”?

9. What role do you believe faculty play in fostering students’ critical thinking?

10. What class assignments, activities, and experiences, do you believe foster students critical thinking? (please provide specific examples)

Appendix E

Profile Sheet for Respiratory Care Faculty

1. What is the highest level of education you have obtained?
   - Bachelor degree
   - Master degree
   - Professional degree
   - Doctorate Degree

2. What is your current faculty employment status?
   - Part-time employed
   - Full-time employed

3. What is your current rank as a faculty member?
   - Clinical instructor
   - Lecturer
   - Assistant professor
   - Associate professor
   - Professor
   - Other

4. Do you have other responsibilities other than teaching in this current program (administrative, leadership, management)?
   - Yes
   - No

5. How many years have you been a respiratory care faculty member?
   - Less than 1 year
   - 1 - 5 years
   - 6 - 10 years
   - 11- 15 years
   - 16 - 20 years
   - 21 - 25 years
   - 26 - 30 years
   - more than 30 years

6. How many years have you been working as a respiratory therapist?
   - Not applicable
   - Less than 1 year
   - 1 - 5 years
   - 6 - 10 years
   - 11- 15 years
   - 16 - 20 years

- 21 - 25 years
- 26 - 30 years
- more than 30 years

7. Have you engaged in any advance training on how to promote students' critical thinking skills?
   - Engaged in formal training
   - Engaged in informal training
   - No training engaged in

8. How would you define "critical thinking"?

9. What role do you believe faculty play in fostering students' critical thinking?

10. What class assignments, activities, and experiences, do you believe foster students critical thinking? (Please provide specific examples)