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# Influence of Problem-Based Learning Instruction on Decision-Making Skills in Respiratory Therapy Students

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INFLUENCE OF PROBLEM-BASED LEARNING INSTRUCTION ON  
DECISION-MAKING SKILLS IN RESPIRATORY THERAPY STUDENTS

By

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Submitted in fulfillment of the  
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## DEDICATION

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## ABSTRACT

**Background and Purpose.** The continuing evolution of respiratory therapist profession requires that today's therapists are now expected to demonstrate advanced levels of patient assessment, problem solving and decision-making skills. In the fall of 1998, the faculty at the respiratory therapy program at the University of South Alabama implemented a problem-based learning curriculum to meet the needs to improve students' decision-making and problem-solving skills. The rationale for focusing on teaching strategies to improve decision-making skills is based upon previous studies in the field of respiratory therapy that have demonstrated a positive relationship between decision-making and critical thinking. However, decision-making in respiratory therapy students has not been widely studied. Therefore, the purpose of this study was to examine the effectiveness of problem-based learning teaching strategies on the decision-making skills of respiratory therapy students and determine if changes occurred over time.

**Subjects.** One hundred students' records who graduated from a baccalaureate respiratory therapy program between the years 1996-2003 at a private university in South Alabama were analyzed. Of the 100 students, 37 were male and 63 were female.

**Methods.** Using a retrospective, correlational research design, DM scores from the NBRC Clinical Simulation Self-Assessment Examination (SAE) and the graduates' actual NBRC Clinical Simulation Exam DM scores were

compared and correlated between the years 1996-1999 time frame which represented the traditional curriculum and the years 2000-2003 which represented the problem-based learning curriculum. **Results.** Statistically significant positive differences in exam scores by type of curriculum were found ( $r = .58, p < .01$ ). DM scores on the NBRC Clinical Simulation Self-Assessment Exam and the graduates' actual exam scores demonstrated a steady increase in mean scores for the students in the problem-based learning curriculum ( $r = .34, p < .01$ ). **Discussion and Conclusion.** The findings support the hypothesis that problem based learning had a significant positive impact on decision-making skills in respiratory therapy students. The results of this study indicate that further investigation of problem-based learning approaches in respiratory therapy students is warranted.



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emphasis on outcomes. Consequently, they state that critical thinking skills and abilities must become the “norm” not the exception.

In 1992, 100% of the participants in a National Consensus Conference on Respiratory Care Education rated the critical thinking abilities of analytical judgement, problem solving skills, and decision making as highly important cognitive skills required of a respiratory care professional. Throughout the literature, critical thinking is now becoming a new focus for educators at all levels, from elementary schools to universities (Miller and Malcolm, 1990). Facione and Facione (1996) state that the public stakeholders, such as faculty, practitioners, accreditation agencies, and policymakers seek valid and reliable evidence of critical thinking as an achieved educational outcome. Hill (2002) states that the continuing evolution of the respiratory care profession requires that every respiratory therapist demonstrate an advanced level of critical thinking, assessment and problem solving skills. These core abilities are essential in today’s health care environment not only to improve the quality of healthcare, but also to reduce overall costs and the number of inappropriate treatments. Respiratory therapists, like other allied health personnel, are expected to participate in the development and modification of patient care plans, therapy protocol administration, disease management and patient education. As healthcare becomes more concerned with quality patient outcomes and cost effectiveness, respiratory therapists’ ability to make autonomous decisions is essential (Hill, 2002).

### The Need For The Study

The Clinical Simulation Exam is one of two board exams administered by the National Board for Respiratory Care that students take after graduation from an accredited respiratory therapy program. This exam measures decision-making skills and is used as an outcome measurement for respiratory therapy programs to assess students' decision-making abilities. "The Clinical Simulation Exams (CSE) from the NBRC are considered by experts in philosophy/social sciences to be one of the few domain-specific instruments for assessment of critical thinking" (Mishoe, et. al., 1997). Nationwide, the pass rate on the Clinical Simulation Exam (CSE) administered by the National Board for Respiratory Care (NBRC) has consistently been around 60%. Currently, the pass rates on the NBRC Clinical Simulation Exam (CSE) are 63.5% for first time test takers and 46% for exam repeaters. (NBRC, 2004). Respiratory programs are seeking new ways to not only improve these results, but also to strengthen their graduates' skills in order to be prepared for today's workforce. Consequently, respiratory therapy educators have investigated new pedagogies documented to improve the critical thinking and decision-making of other health professions students and that may also influence the decision-making of future respiratory therapists.

Problem-based learning, a relatively new pedagogy, has been implemented in several respiratory therapy schools throughout the nation as a response to meet the educational needs of future practitioners. Problem-

based learning is a student-centered method of teaching in which learning is fostered by active inquisition (Dolmans and Schmidt, 1996). The basic premise is that students accept the major responsibility for their own learning. The classroom is transformed from that of the traditional passive-style lecture to one of active participation by students in small groups where questions are raised, hypotheses are proposed, data is presented by fellow classmates, and the teacher's role is that of a facilitator. The problem-based learning process consists of a problem which is presented to the student cohort. The student cohort then identifies the learning objectives and use clinical reasoning and decision-making in an interactive group process. Independent self-study and the application of newly attained knowledge as it relates to the problem is then followed by the cohort developing a summary of what has been learned (Barrows, 1985, p. 15). This teaching method has been documented to improve critical thinking abilities, to motivate self-directed learning, and to provide structure of knowledge into real-life contexts (Barrows, 1998).

In two similar correlation studies involving respiratory therapy students, Hill, (1999) and (Mishoe et al., 1997) demonstrated that statistically significant relationships exist between students' critical thinking abilities and decision-making skills as measured by the decision-making scores on the National Board for Respiratory Care Clinical Simulation Exams. While it is difficult to actually determine cause and effect, both studies have suggested that additional research is needed in this area to examine the effectiveness of individual educational strategies. Presently, there are a limited number of

studies which investigate decision-making skills of respiratory therapy students comparing the effectiveness of diverse educational strategies.

### Purposes of the Study

The respiratory therapy program at the University of South Alabama implemented a problem-based learning curriculum in response to the need to improve students' critical thinking and decision-making skills. This program was first implemented in the fall of 1998 and is currently in effect. Initial program evaluation was conducted in the spring of 1999 with the administration of the NBRC Clinical Simulation Self-Assessment Exam. Eleven of 12, or 92% of the students achieved a score of 70% or better with the average score being 75% or greater.

The purpose of this study is to examine the effectiveness of problem-based learning teaching strategies on the decision-making skills of respiratory therapy students. Students' decision-making scores as measured by the NBRC Clinical Simulation Self-Assessment Exam following graduation are analyzed. These scores will be compared from graduates in the traditional curriculum from the years 1996-1999 to graduates in the new problem-based learning curriculum from the years 2000-2003.

The results from this study will benefit allied health educators in several ways. First, there are limited studies within the field of respiratory therapy which are targeted specifically at teaching strategies designed to improve students' decision making abilities, such as problem-based learning. Mishoe et. al (1997) demonstrated that the implementation of problem-based

learning in a bachelor's degree respiratory program significantly improved the problem solving aspects of the students' critical thinking. This was measured using the Watson-Glaser Critical Thinking Skills Test. Furthermore, Hill (1999) demonstrated that among ten respiratory therapy programs, problem-based learning was one of the most widely utilized teaching methods to improve students' critical thinking skills, and again, was measured by the Watson-Glaser Critical Thinking Skills Test. These authors have challenged future respiratory educators to study the effectiveness of educational strategies designed to promote the development of critical thinking and decision-making. Second, if students' decision-making scores do change after completion of a specific class or curriculum designed to improve their decision making skills, the outcomes can be used to incorporate these strategies into the curriculum. Third, other allied health educators can benefit from the results of such studies and utilize this information to make the necessary curricular changes to benefit their students' educational outcomes.

#### Research Question

Does a significant positive relationship exist between students' decision-making scores on the National Board for Respiratory Care Clinical Simulation Exam for graduates of the problem-based learning curriculum at the University of South Alabama Respiratory Therapy Program when compared to the traditional curriculum?

### Hypothesis

There is a statistically significant positive change in students' decision-making scores on the NBRC Clinical Simulation Exam after completion of a baccalaureate respiratory therapy program which utilizes a problem-based learning curriculum as compared to the students' decision-making scores from the traditional curriculum.



## Chapter II

### REVIEW OF THE RELATED LITERATURE

#### Critical Thinking Defined

There is no one specific definition of critical thinking, yet many of the definitions share similar concepts. Steven Brookfield (1987), a renowned author, defined critical thinking as the process of reflecting on the assumptions underlying ideas and actions of ourselves and others, and contemplating alternative ways of thinking and acting. In 1990, the American Philosophical Association conducted a Delphi report which included 46 experts, teachers, theorists, and critical thinking specialists from many disciplines to describe the core cognitive skills of the critical thinker. They stated that the habits or the personal dispositions of the critical thinker are “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” (American Philosophical Association, 1990, p. 3). This expert definition identifies the core cognitive skills as interpretation, analysis, inference, evaluation, and explanation. They

distinguished critical thinking to be a process of focused, self-opinionated judgment, which enables one to exhibit interactive, reflective, reasoning processes. For example, when one is critically thinking, they will analyze and evaluate their own inferences and provide reasons backed up by substantial evidence for purposeful judgments (Facione, 1998). To critically think whether alone or in a group, people will utilize this metacognitive self-regulation skill to monitor, correct and improve the process of coming to a reasonable judgment (Facione, 1998).

Richard Paul, the Director of the Center for Critical Thinking and Chair of the National Council for Excellence in Critical Thinking, has authored over 50 articles and five books on critical thinking. Paul (1993) states that "Critical thinking is thinking about your thinking while you are thinking in order to make your thinking better" (p. 91). In summary, it is self-improvement in our own thinking by using principles which assess our thinking. Paul asserts that students should be disciplined in their reasoning skills and base their decisions on substantiated evidence. When we have problems to solve, we must utilize our critical thinking abilities to work our way through the problem. Good communication and writing skills, a healthy sense of self-worth, a natural curiosity, and a burning desire to learn and questioning the unknown are other elements that are essential of the critical thinker. The critical thinker must possess the courage to persevere, and to have faith in their reasoning skills. "They must be willing to work, to suffer through confusion and frustration, willing to face limitations and overcome obstacles, be open to the

views of others, and be willing to entertain new ideas that many people find threatening" (Paul, 1993, p. 96).

There are many other definitions of critical thinking, which contribute to the concepts of critical thought. Harvey Siegel (1980) has defined critical thinking as thinking appropriately moved by reasons. Here the individual makes decisions based upon rational thought. For example, if I do this, what will the consequences be? He also argues that students must first be taught how to develop the critical spirit in order to become a critical thinker. The student will learn how to scrutinize beliefs and practices and to understand the role that reasons play in justifying a thought or action.

Robert Ennis (1985) defines critical thinking as "reflective and reasonable thinking that is focused on deciding what to believe or do" (p. 45). In this case, one will reflect upon their decision in relation to their individual beliefs, and be willing to consider alternative choices. Mc Peck (1981) states that critical thinking is "the propensity and skill to engage in an activity with reflective skepticism" (p. 81). In this case, one will look at all the evidence presented and reflect upon theories and criteria in order to solve the problem. Mathew Lippman (1988) defines critical thinking as "skillful, responsible thinking that is conducive to judgement because it relies on criteria, is self-correcting, and is sensitive to context" (Paul, 1993, p.207). In this case, the individual will clearly understand the difference between responsible and irresponsible thinking, the appropriate use of criteria and how to self-correct their thoughts when solving problems.

Paul differentiates thinking into two categories. Weak sense critical thinking and strong sense critical thinking. He describes weak sense critical thinking as logical in nature, self-centered, and lacking in the ability to consider other points of view or to defend opposing arguments. The weak sense critical thinker also lacks the fundamental dispositions towards critical thinking, which includes inquisitiveness, open-mindedness, cognitive maturity, truth seeking, analyticity, systematicity, and confidence in their reasoning abilities. Weak sense critical thinkers lack the ability to critique and analyze even their own thoughts. As a result, this also leaves the weak sense thinker lacking in the ability to enter sympathetically into and to reconstruct the strongest arguments and reasons for points of view fundamentally opposed to their own (Paul, 1993, p. 206). Paul further contends that the weak sense critical thinker possesses mono-logical thought processes and that they only think within their own frame of reference.

The NBRC Clinical Simulation Exam consists of 10 patient management problems in which the test taker must first read the patient scenario, then gather the appropriate information based upon the case, interpret the results of this data, and finally make the appropriate treatment decisions. Thus, the two parts of the exam are known as information gathering and decision-making. There is only one way to solve the problem. Students lose points if they gather the wrong information and make ineffective decisions. The exam only provides the examinee with one context of thinking and does not allow for interactive, reflective, critical reasoning

processes. The decision may change based upon the context in a clinical setting; however, the exam is not measuring this. The decision-making scores as measured by this exam can be compared to Paul's construct of weak sense contextual critical thinking. Critical thinking in the weak sense can be described as a process occurring within a given framework, limited to logical reasoning, and often incorporates creative activities within the given context (Beckett, 1996). To complete the decision-making process on this exam, the student is required to logically find solutions based upon strategic, sequential steps within a specific context. It is not requiring the thinker to consider other points of view and to reconstruct opposing arguments.

Conversely, the strong sense critical thinker possesses a more global construct of thinking and dispositions towards critical thinking. They can reason multi-logically, which is the ability to recognize when one's own point of view is weakest versus when it is the strongest. They also deeply question their own framework of thought, and to reconstruct sympathetically and imaginatively, the strongest versions of points of view opposed to one's own (Paul, 1993).

### The Importance of Critical Thinking

The work environment in healthcare today is changing so rapidly placing incredible demands on the practitioner's clinical decision making skills Colluciello (1997). Respiratory therapists are required to assess the patient, analyze and evaluate their condition, and establish appropriate

recommendations to the physician (Hill, 2002). A review among the allied health literature (Adams, 1995; Beckie, Lowry & Barnett, 2001; Bowles 2000; Colluciello, 1997; Hill 2002; Leppa ;1997; McCarthy, P., Schuster, P., Zehr, P., & McDougal, D., 1999; Saucier, Stevens & Williams, 2000; Spelic, Parsons, Hercinger, Andrews, Parks, & Norris, 2001; Thompson & Rebesch, 1999) reveal that in order for our graduates to be successful, critical thinking, evaluation and the ability to analyze information must be demonstrated. Graduates must be able to defend their own point of view, but be willing to question and accept other points of view as well. This requires a certain amount of intellectual humility, flexibility and courage. In addition, one has to continually assess their own thinking to identify strengths and weaknesses in order to yield a well-reasoned answer that is supported with factual information.

Assessing student critical thinking abilities is an ongoing problem and is not new to curricula. Nursing, physical therapy, and respiratory therapy professions are all declaring the need to incorporate critical thinking into the curriculum. According to Leppa (1997), educators in all disciplines feel the need to document the work of professors and students in ways that can be communicated to the public. Increased scrutiny by legislators and a “crisis of public confidence” demand accountability from the higher education community. In 1989, the National League for Nursing (NLN) included critical thinking as a specific criterion for the accreditation of BSN programs. The criterion states: “the curriculum emphasizes the development of critical

thinking and of progressively independent decision making” (Miller & Malcolm, 1990, p. 67). Because of this criterion, nursing programs must now document how they are both teaching and assessing students’ critical thinking skills, (Miller, M.A. and Malcolm, 1997).

### Critical Thinking in Respiratory Care

Respiratory therapy programs must also document the assessment of students’ critical thinking abilities by reporting students’ scores on the National Board for Respiratory Therapy credentialing exams annually to the Committee for Accreditation on Respiratory Therapy Education. Students take these exams prior to exiting the respiratory therapy program for self-assessment purposes and they then have the opportunity to take the exams once they graduate to obtain their entry level and advanced credentials. The Clinical Simulation Exams from the NBRC are considered by experts in philosophy and the social sciences to be one of the few domain-specific instruments for the assessment of critical thinking (Mishoe & Dennison, 1997).

Hill (2002) conducted a correlational study of 143 respiratory therapy students and found that students with strong critical thinking proficiency make better clinical decisions. Specifically, decision-making scores from the NBRC Clinical Simulation Self-Assessment Exam were compared with scores from the Watson-Glaser Critical Thinking Appraisal for 143 graduating respiratory therapy students from 10 programs. The exams were administered prior to

graduation from the programs. This study demonstrated a significant correlation between critical thinking and decision-making scores ( $r = 0.32$ ,  $p < 0.01$ ). There were no significant differences found in the distribution of the gender, years of college experience, or months of clinical experience of the students in different programs. There was a small correlation found between age and critical thinking ( $r = 0.18$ ,  $p < .05$ ). However, statistically significant relationships were identified between GPA and critical thinking ( $r = 0.40$ ,  $p < .01$ ), and GPA and decision-making ( $r = 0.325$ ,  $p < .01$ ). This significant relationship between GPA and critical thinking has been demonstrated by Berger (1985) in previous studies utilizing the Watson-Glaser Critical Thinking Appraisal Test.

In a similar correlation study, Mishoe & Dennison (1997) reviewed the records of 60 respiratory therapy students enrolled in bachelor programs from 1993-1996 and compared their decision-making scores on the clinical simulation exam with critical thinking scores using the Watson-Glaser Critical Thinking Test. Specifically, they found a significant correlation ( $r = 0.34$ ) between critical thinking scores and decision-making scores. They also found that GPA was significantly related to the Watson-Glaser Critical Thinking Appraisal scores and the decision-making scores. Students with a higher GPA and greater critical thinking abilities could be expected to perform better on the clinical simulation exams.

Mishoe et al. (1997) also examined the critical thinking scores of 72 respiratory therapy students enrolled in two bachelor degree programs over a



three year time frame (1993-1996), using the Watson-Glaser Critical Thinking Appraisal Test. A pretest-posttest design was used to evaluate critical thinking at the beginning of the program and prior to graduation. In this study only a significant improvement was found in the class of 1996, which may be attributed to the implementation of problem-based learning in several classes during that year. However, there was no further information given as to the details of the implementation of this pedagogy.

In a more recent study, Zettergren and Beckett (2004) used a cross-sectional design to study 200 students enrolled in a 5-year, professional Master of Physical Therapy degree program. The students completed the California Critical Thinking Skills Test (CCTST) at the midterm portion of their fall 2003 semester. Data was collected on students from the third year through the fifth year in the program. The authors found statistically significant differences between the scores of the third year students and the scores of the fifth-year students ( $M = 2.59$ ,  $P = 0.000$ ), as well as those of the fourth-year and fifth-year students ( $M = 1.81$ ,  $P = 0.05$ ) were found. The authors concluded that although they may not understand all the variables that affect critical thinking, an obvious and significant change occurs from the third year to the fifth year at this target university. They postulated that the 8-week clinical internship following the fourth year of study, and the additional years of didactic education had a significant impact on students' critical thinking scores.

In a comparative study within the field of respiratory therapy, the effects of problem-based learning on students' critical thinking skills in a bachelor degree program were examined. 72 students from two respiratory therapy programs during the years 1993-1996 completed the Watson-Glaser Critical Thinking Appraisal (WGCTA) at the beginning of the program and prior to graduation. The Watson-Glaser Critical Thinking Appraisal instrument is considered to be the best single measure of critical thinking (Mishoe et. al 1997). Statistically significant changes in critical thinking skills as measured by the Watson-Glaser Critical Thinking Appraisal were noted in the last class of students (1996). The authors felt that the educational changes to facilitate problem-based learning significantly impacted the students' problem solving aspects of critical thinking. These two studies were similar in design and methodology in that they both examined students' critical thinking scores utilizing an established critical thinking skills test and correlated the results to educational outcomes. The authors all suggested that the need still exists for more research within respiratory therapy and physical therapy programs to examine further the effectiveness of individual educational strategies used to improve students' critical thinking and decision-making abilities.

### Problem-Based Learning Definitions

Problem-based learning has been used in medical schools for over 30 years, in nursing schools for over 10 years, and has recently spread into allied health disciplines (Baker, 2000). The McMaster University in Canada has seen many of its educational programs implement the problem-based learning format as such they have become the pioneers of the problem-based learning curriculum model (Gallagher, 1997). The educators found that medical students could be educated more effectively with this method as opposed to traditional methods (Gallagher, 1997). They needed to be taught to learn the facts, know the right answers, be flexible thinkers, but to most of all, ask the right questions as a means of learning all the knowledge in order to be the best problem solvers. The expectations for the graduates were for increased retention of information, increased critical reflection, and the application and evaluation of this knowledge. The McMaster model calls for a complete overhaul of the curriculum and the instructional methods where the entire program is taught using problem-based learning.

H.S. Barrows (1980) defines problem-based learning as the learning that results from the process of working toward the understanding or resolution of a problem (p. 18). The problem is encountered first within the learning process and serves as the stimulus for the application of problem-solving skills in addition to the seeking out of new knowledge needed to resolve the problem at hand. Real life patient problems are most frequently used to achieve the objectives. Problem-based learning creates the

opportunity for the learner to find knowledge for oneself, to contrast one's understanding of that knowledge with another's understanding, and to refine or restructure knowledge as more relevant experiences are gained. The expected outcomes of problem-based learning is that it develops clinical reasoning, structures knowledge in real-life contexts, motivates learning, and develops self-learning skills (Barrows, 1998).

In a more recent article, Barrows (1998) identifies three educational objectives that must be addressed by problem-based learning in order to be effective. Knowledge must be integrated from a variety of disciplines and structured in ways to facilitate the necessary analyzation skills for students to solve patient problems. Self-directed learning and team interpersonal skills must also be developed, in addition to an insatiable curiosity and a burning desire to continually learn (Barrows, 1998). In order to achieve this, the problem-based learning curriculum must be student centered, where the responsibility of learning is now transferred from the teacher to the student and faculty are responsible now as guides or to be a facilitator. The tutor facilitates the application and development of an effective problem-solving process by assisting the students with hypothesis generation, deductive inquiry, data analysis, problem synthesis, and decision making (Barrows & Pickell, 1991). In addition, students must collaborate with each other to consult a variety of resources, such as textbooks, journals, and the Internet, which will build upon their teamwork skills and foster independent learning. He further states that the problems must be real patient problems that the

student will face in daily clinical practice, and therefore, be able to integrate these cases to future patient problems. The McMaster team utilized simulated patients drawn from real patient files to foster this type of learning (Gallager, 1997). Finally, students must be allowed to perform both peer and self-assessments so they can learn from constructive feedback.

Charles Engel (1985) views problem-based learning as a way of lifelong learning. It is “a means of developing learning for capability rather than learning for the sole sake of acquiring knowledge” (Boud & Feletti, 1997, p. 20). Engel states that students who learn with the problem-based learning method will be prepared for lifelong learning by becoming flexible, adaptable, active participants in the multitude of changes throughout their journey in their lives. He states that each individual will develop “core competencies such as good communication skills, critical and reflective reasoning abilities, and a logical and analytical approach to problem solving that uses self-evaluation” (Boud & Feletti, 1997, p. 21). This will be accomplished through a total curriculum revision whereby students will be able to develop and master their specific objectives, which will enable them to embark on their lifelong learning journey.

Crucial to problem-based learning, Wilkerson and Feletti (1989) purport that “the problems raise compelling issues for new learning and that students have an opportunity to become actively involved in the discussion of these issues, with appropriate feedback and corrective assistance from faculty members” (Wilkerson & Feletti, 1989, p. 53). The faculty role is to

facilitate the problem-solving process, to guide, probe, and support students' initiatives, not to lecture, direct or to provide solutions.

Problem-based learning is notably different from the case-based method in that in problem-based learning, the problem is presented first, prior to learning even the basic science or clinical concepts, not after. Fincham and Schuler (2001) have identified three necessary ground rules for problem-based learning groups. A faculty member must first develop a problem that is to be used as the foundation to meet the learning objectives and to make sure that these problems provide the content necessary to achieve the stated objectives (Fincham & Schuler, 2001). In addition, these authors recommend that the problems be "real or ill structured" in that the problem represents reality as closely as possible. Second, the learning must take place in small groups, approximately five to seven students to ensure participation of all the members. The small group provides a safe haven whereby students can identify with each other on such issues as: a lack of understanding, support and encouragement from their peers which will lead to the growth of the entire group. They learn both trust and responsibility as active members of the group. In addition, they become comfortable both giving and receiving criticism.

Third, the learning must be student-centered. In a truly student-centered environment, faculty must recognize the importance of students in the learning process and understand that the content must be appreciated by the students before they will become motivated to master the material

(Fincham & Schuler, 2001). In problem-based learning, students are expected to master the material outside the classroom both individually and within their small groups. Proper scheduling of “study time” is a key component within a problem-based learning curriculum. Using this approach to learning, students demonstrate more enthusiasm to learn and have the added confidence to understand the uncertainties when solving clinical problems. The memorization of isolated facts, taken out of context, is deemphasized. Time is thus an essential structural component of a problem-based learning curriculum.

#### Outcomes of Problem-Based Learning

There is a plethora of research on problem-based learning in the medical field (Albanese & Mitchell, 1993, Baker, 2000). A summary of the research conducted by Albanese & Mitchell, (1993) and Vernon & Blake, (1993) demonstrated that students in problem-based learning curricula exceeded traditional students in clinical knowledge tests, clinical performance, and satisfaction with their academic program (Baker, 2000). It is important to preface, that to analyze the outcomes of the studies conducted on problem-based learning in health care disciplines can be difficult due to the numerous definitions of problem-based learning and how it is implemented into the curriculum. Problem-based learning has been approached in three ways as identified in the literature: (1) A completely integrated curriculum which focuses all learning of content around health care scenarios; (2) A transitional curriculum which utilizes more traditional learning approaches in

the beginning of the program and then there is a gradual shift to content integration, small group work, and a more student centered approach as time progresses; and (3) problem-based learning that has been implemented as a single course approach.

In summary, problem-based learning within a problem-based curriculum enhances the transfer of learning to new problems and clinical application, promotes increased retention of knowledge, increases intrinsic interest in the subject, and strengthens self-directed learning skills (Norman & Schmidt, 1992). Another meta-analysis on problem-based learning documented that students have enhanced problem-solving and clinical reasoning skills, and students' knowledge reveals improved retention, retrieval, and application in clinical settings. In addition, graduates demonstrate a more holistic approach to patient care, it is enjoyed more by both students and faculty, and the curriculum is inherently current and evidence-based.

Recent research in the dental arena demonstrated that students in the problem-based learning curricula scored significantly higher than traditional students in all four discipline-based portions of the National Dental Board Examination (Shuler & Fincham, 1998). In a longitudinal study, the scores from Part 1 of the National Dental Board Examination were examined for the students from the years 1995-1997 at the University of Southern California Dental School between the traditional track and the problem-based learning track. In addition, the scores from the problem-based learning track were



compared with the board results nationwide. No significant differences were noted between GPA and age. The problem-based learning track (n = 12) was compared to the traditional track of (n =130). Independent t-test results demonstrated that the problem-based learning students scored significantly higher than the traditional students (df = 15.649, t = 4.398, p < .001). The mean scores on each component part of the exam, and the overall average, were also higher for the problem-based learning track when compared to the national results on the July 1997 Part 1 National Dental Board Examination. The authors stated that the results of this study demonstrated that the problem-based learning pedagogy “builds a basis for critical thinking and self-evaluation as well as a strong group process for cooperative learning” (Shuler & Fincham, 1998, p. 669). Working as a group, students were able to identify their weaknesses and to continually evaluate and refine their knowledge base during preparation for the exams. This also demonstrated that students were able to apply their self-directed learning abilities to enable them to improve their problem solving skills.

In another study, dental students in problem-based pre-clinical courses exceeded traditional students on a standardized oral comprehensive examination (Login et al., 1997). Utilizing a retrospective study design, the academic performance scores on a standardized oral comprehensive exam for 80 students who graduated from the Doctor of Dental Medicine program at the Harvard School of Dental Medicine between 1991 and 1994 were examined. The scores were compared for students who were taught basic

science in a problem-based learning curriculum and a lecture-based learning curriculum. This exam was administered to the students six months after completion of their basic science courses. Despite the small ( $n = 80$ ) across all the classes, this study demonstrated that students in a basic science curriculum taught by a problem-based method performed better on the oral comprehensive exam than students taught in the lecture-based learning curriculum.

Also, the research in the nursing sector involving problem-based learning has demonstrated positive outcomes as well. Happell (1998) reported that students' interest heightened in the subject in a course based study. White, Amos, and Kouzekanani (1998) reported an increase in critical thinking abilities of students enrolled in a Texas school of nursing. In a qualitative study, using a questionnaire, they evaluated 24 Registered Nurse students after completion of a 1-year course using problem-based learning. Despite the small sample size, ( $n = 24$ ), the other outcomes reported that the students wanted to be active learners, enjoyed the teamwork and research that problem-based learning promoted, and personal growth.

In a similar study, Cooke and Moyle (2002) introduced problem-based learning to 130 nursing students in Australia over a 4-week period and analyzed the students' responses to the use of problem-based teaching/learning strategies. The study demonstrated that the problem-based learning approach promoted critical thinking and problem solving; active participation in the learning process including self-direction, identification of

one's own learning needs, teamwork, creative discussion and learning from peers; and the integration and synthesis of a variety of knowledge. No standardized test of critical thinking was utilized in this study. The students reported that their critical thinking skills were improved through the identification of learning issues, testing hypothesis, determining clinical judgments, and plans of care through synthesizing and analyzing information to make effective clinical decisions (Cooke & Moyle, 2001). This study also found that students found this type of learning to be realistic, fun and interesting, and gave the student more control over their learning. In summary, the results of these studies demonstrate many positive implications for the potential that problem-based learning has for all allied health curricula.

Research in physical therapy education has also demonstrated a positive relationship between problem-based learning and the improvement of clinical reasoning skills. In 1990, the physical therapy program at the Mc Master University developed a completely integrated problem-based learning curriculum. This new program was fashioned after the Mc Master University Medical School, which had pioneered the problem-based learning curriculum in the 1960's. This model incorporated the presentation of the entire curriculum with the problem-based learning format. Physical therapy educators were faced with new educational challenges such as clinical reasoning, decision-making, and critical review to educate professionals who could critically think (Saarinen-Rahikka & Binkley, 1998). To date, the Mc Master program is a 2 year undergraduate physical therapy program which

utilizes a completely integrated problem-based learning curriculum. The findings from the review of this program from 1990 to 1996 indicate that problem-based learning promotes a self-directed, student centered, responsible learner. Other outcomes noted included enhanced problem-solving and clinical reasoning skills, improved knowledge retention, retrieval and application in clinical settings. This type of learning was also more enjoyable for both faculty and students.

John R Jefferson (2001), an Assistant Professor of Physical Therapy at the University of South Alabama, discusses several issues in a review of problem-based learning as a choice for improving students' problem solving skills in physical therapy curricula. He stated that while problem-based learning does help students develop effective and efficient problem-solving skills, that its use in a curriculum should be selective and highly structured when the institutional goal is the promotion of clinical problem-solving skills. If instructors are going to utilize problem-based learning then they should incorporate the "true" curricular wide strategy which uses cooperative learning (Jefferson, 2001). "In cooperative or collaborative learning, students work in small groups to achieve a common goal" (Jefferson, 2001 p. 26). The role of the teacher shifts from passive as in lecture format to an involved facilitator. The learning is more active, and student centered, and is now dependent upon the self-directed efforts of the small groups (Jefferson, 2001). This pedagogy will foster team work among the students, increase independent learning, and promote metacognition. Jefferson defined

metacognition as “people’s knowledge of their own learning and cognitive processes and their consequent regulation of those processes to enhance learning” (Jefferson, 2001, p. 27).

Jefferson (2001) identified and described four hallmark characteristics of problem-based learning. First, the teaching method is different in that students’ work in small groups with the teacher whose role shifts to that of tutor or facilitator. The students’ learning becomes more self-directed and group driven. The average size of the groups is 5-6 students. Students identify the learning issues within their own group, and then they identify and use a variety of learning resources to study the learning issues. They then return to the group to discuss what they have learned. The groups meet on an average of 2-3 times per week for about 3-hour sessions. Second, it is a problem-first approach whereby new knowledge arises from working on a problem. Third, it is integrative across the disciplines with an emphasis on open-ended problems. Finally, the evaluation methods place more emphasis on group feedback and ongoing self-assessment (Jefferson, 2001).

It is difficult to analyze and synthesize educational outcomes of problem-based learning research in the allied health arena due to different definitions of problem-based learning, various forms of implementation, whether it was the entire curriculum or a single course, the wide range of study designs, and the outcome criteria for evaluation. However, the main themes that all of these study outcomes have in common are that it strengthens clinical reasoning and decision-making skills, (Mishoe, et al,

1997), fosters active learning and participation, and increases self-study skills (Norman & Schmidt, 1992), and encourages team work and enhances life-long learning behaviors, and helps students develop effective and efficient problem-solving skills (Jefferson, 2001).

Furthermore, a summary of two studies by Albanese & Mitchell (1993) and Vernon & Blake (1993) that utilized meta-analysis to assess 20 years of evaluative research on health related educational programs using problem-based learning, have documented many positive outcomes for faculty and the students alike. They found that faculty have increased job performance and satisfaction, students and graduates were more satisfied, and finally, there was noted decreased stress in the learning environment. The results of these studies are encouraging and demonstrate that as adult learners, students want to be an active part of classroom teaching. Faculty members enjoy the small group environment. In addition, problem-based learning is definitely a pedagogy that can inject a renewed enthusiasm into the classroom environment.

#### Curriculum Designs of Problem-Based Learning

Solomon, Binkley, and Stratford (1996), in a comparative study of two physical therapy curricula, have identified three approaches to problem-based learning: (1) completely integrated problem-based learning curricula, (2) transitional curricula, and (3) a single course approach. In the integrated approach, the entire curriculum is taught using the problem-based learning

methods. The transitional curriculum utilizes a more traditional approach in the early stages and then gradually phases in the problem-based learning method over time as students' progress through the program. Many programs have experimented with problem-based learning by implementing the method to teach only one class out of the entire curriculum to reap some of its benefits (Solomon, et al. 1996). In other allied health arenas, there is evidence that problem-based learning has been limited to single courses or curricular blocks (Bell, 1993, Forrest, Walsh & Isaacs, 1998). This approach suffers from the drawbacks in that the integration of curricular content is limited, and students are faced with the confusion of drastically contrasting pedagogies within the same time frames (Fincham, & Shuler, 2001). In this case, students are more likely to resist the transition to the new student centered learning environment and feel more comfortable in the traditional curriculum. Although the studies in the literature are varied in their designs, such as how the problem-based learning is implemented, whether it is the entire curriculum versus a single course, and the definition of problem-based learning, they all have a similar prevailing theme, that problem-based learning enhances problem solving abilities, improves clinical decision-making, fosters self-directed learning skills, and improves both faculty and student satisfaction with their academic program (Vernon & Blake, 1993).

Vernon and Blake (1993) conducted five separate meta-analyses on 35 studies, representing 19 medical schools in the United States from the years 1970 through 1992, comparing problem-based learning with more

traditional methods of medical education. The studies varied in their research designs, the method by which the problem-based learning was implemented into the program, whether it was a single course, versus an entire curriculum or even segments of a course, as well as the outcome measure for evaluation. Sample sizes ranged from an  $n = 33$  to an  $n = 790$ . The outcome variables were grouped into four general areas: (1) program evaluation (student attitudes, student mood, class attendance and faculty attitudes); (2) academic achievement which included scores from the National Board of Medical Examiners Part I exam; (3) other exams, academic problems and student attrition, academic process (approaches to learning and resource use); and (4) clinical functioning (performance tests and ratings, humanism, and clinical knowledge). The results demonstrated that the problem-based learning approach to education was significantly greater than the traditional format in all of the outcome domains examined except on the second outcome variable, the National Board for Medical Examiners Exam Part 1. The traditional teaching methods were associated with higher scores on this exam than the problem-based learning; however, these results were affected by the size of the study samples and all the discrepancies between the samples as well. With respect to clinical functioning, the performance of the problem-based learning students as measured by tests of clinical knowledge, observations of behaviors with real or simulated patients, and "humanism" behaviors as rated by Harvard's problem-based learning program was better than that of traditional students. The authors noted that the independent



variable of problem-based learning is very difficult to study due to the complex nature of the teaching method itself. Consequently, Vernon and Blake (1993) have postulated that research study designs need to be more rigorous and effective in order to address the value and effects that problem-based learning affords. The researchers reported other limitations such as confounding, selection bias, and lack of random assignment in the experimental design studies, which in turn narrows the scope of the overall generalizability of this study.

Conversely, another meta-analysis was conducted on the problem-based learning literature during approximately the same time frame which utilized a similar definition of problem-based learning, reviewed much of the same literature, and was similar in its approach to the research outcomes. However, Albanese and Mitchell (1993) took a slightly different approach to their methodology in that they used studies involving problem-based learning with different research designs and they excluded smaller studies in their final analysis. However, despite their overall differences, the two reviews were similar in their overall conclusions. With regard to "student satisfaction" and "clinical performance", both reviews favored problem-based learning versus the traditional format.

In contrast, the Vernon and Blake study included two major analyses for the category of academic achievement, the National Board for Medical Examiners Test Part I, and other tests of factual knowledge, while the Albanese & Mitchell study reviewed data only involving the standardized

National Board for Medical Examiners test. There were similar trends which were called "less than definitive". Overall, both studies supported the pedagogy of problem-based learning and suggested that it is "more nurturing and enjoyable by both faculty and students, and problem-based learning graduates perform better on clinical evaluations and faculty evaluations" (Albanese and Mitchell, 1993, p. 52).

### Problem-Based Learning and The Potential For Respiratory Therapy

#### Education

Critical thinking is increasingly recognized as a crucial component of professional practice in an outcomes-oriented environment. Presently, this issue is at the forefront of respiratory therapy education and it has triggered the profession to examine its educational direction and to determine an agenda for change (Cullen et al., 1993). Developing critical thinking in respiratory therapy students has been proposed as a method for improving clinical decision-making, based on the hypothesis that a positive relationship exists between decision-making and critical thinking (Mishoe, 1993; Mishoe, et. al, 1997). In addition, recent studies in the respiratory profession have looked at critical thinking skills and decision-making skills and have correlated these results with standard tests of critical thinking, such as the Wastson-Glaser Critical Thinking Skills Test or the California Critical Thinking Skills Test and Disposition Test (Hill, 1999, Johnson and Van Scoder, 2002). The

1999 study by Hill demonstrated a positive correlation between students' critical thinking skills as measured by the Watson-Glaser Critical Thinking Skills Test and decision-making scores as measured by the National Board For Respiratory Care Clinical Simulation Exam.

Conversely, the 2002 study by Johnson and Van Scoder did not demonstrate statistical significance between students' critical thinking skills as measured by the California Critical Thinking Skills Test and The California Critical Thinking Disposition Inventory (CCTDI) with students' exam scores on the National Board For Respiratory Care Written Exam. This study examined 17 senior students in a bachelor degree program who took both the California Critical Thinking Skills Test (CCTST) and The California Critical Thinking Disposition Inventory (CCTDI). The CCTST is designed to measure the skills component of critical thinking and has five subscales (analysis, deduction, induction, evaluation, and inference). The CCTDI has seven subscales (truth seeking, open mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity). About four months later the students took the computer based NBRC Written Registry Exam. Although data exists from all of the aforementioned studies documenting a positive relationship exists between critical thinking and decision-making, cause and effect cannot be determined due to the lack of a true experimental design and various other confounding variables.

The response by educators nationwide to meet these changing demands placed on the graduates of the respiratory care profession has

included multi-skilling, interdisciplinary education, consortia and articulation agreements among institutions, increased attention to geriatrics and therapist-driven protocols, education in smoking cessation and asthma education, distance learning methods, and the use of problem-based learning (Op't Holt, 2000). A primary goal of problem-based learning is to foster effective critical thinking skills and to improve clinical problem solving (Barrows, 1998). The excellent potential of problem-based learning to promote critical decision-making for respiratory therapists can be inferred from research from other allied health disciplines and the emerging research from nursing schools in Canada, Australia, and the United Kingdom (Baker, 2000). Respiratory therapy faculty must not be reluctant to change, but more importantly, need to recognize the positive impact that this valuable educational paradigm shift can have on the success of their future graduates. As suggested by Hill (2002), additional research is needed in the effectiveness of individual education strategies involving their effects on critical thinking and decision-making skills.

## METHODS

### Research Design

This study utilized a retrospective correlational research design (*ex post facto*) to describe the relationship between problem-based learning and decision-making skills of respiratory therapy students enrolled in the baccalaureate program at the University of Alabama between the years 1996-2004. Decision making scores from the NBRC self-assessment clinical simulation exams were used as objective measures. Subjects' scores on the variables were measured and then used to describe the relationship. The basic premise behind this study design was to describe and predict relationships among certain variables.

### Subjects

The subjects consisted of a convenience sample of all graduates (N = 100) enrolled in a four-year baccalaureate respiratory therapy program at the University of South Alabama between the years 1996-2004.

### Implementation of Problem-Based Learning

In this program, students participated in two years of general liberal arts education, followed by two years of respiratory therapist education. The junior year of the program began with an 8-week course in respiratory anatomy and physiology, patient assessment, and basic respiratory therapy.

Students were instructed on the problem-based learning process during the patient assessment course. Following the eight week introduction period, students then participated in all respiratory therapy classes taught using the problem-based learning format along with clinical practicums. Students worked with live patients who presented with many similarities of the patients in the problem-based learning courses such as: chronic obstructive pulmonary disease, post-operative pulmonary conditions, pneumonia, and other non-intensive pulmonary problems (Op't Holt, 2000).

The core of the problem-based learning methodology at the University of South Alabama consisted of a small tutorial group of 5-7 students per group and a faculty member who facilitated the group process during each of the three sessions per week. The faculty utilized "real patient cases" and provided information including the patient's chief complaint, history and physical exam, laboratory tests, and progress notes. This served as a basis for learning the contents of cardio-respiratory care and for students to construct an appropriate plan of care for the patient. Students utilized this information along with an appendix provided by the instructor. This included an abstract, suggested learning issues (objectives), resources with page and chapter references, and the National Board for Respiratory Care Exam Matrix references. This information was used to identify personal learning issues and the relevant topic for further independent study. Students then utilized outside resources (such as the Internet, journal articles, textbooks and other

printed sources) to prepare them for their next class meeting. Further learning issues were identified and studied as they arose.

At the beginning of the case, a recorder was identified. The recorder documented essential information, such as pertinent facts, hypotheses (assessments), and learning issues on an erasable board. A reader was also identified to read aloud each page of the case as it is distributed. Another student role played the patient for the other students to practice their history-taking skills. As the case unfolded, students identified the facts of the case. They spent time to brainstorm and list other possible assessments based upon their findings to confirm or rule out assessments. At the conclusion of each session, a list of learning issues were addressed, and the students evaluated the session by determining if the process was followed and if they believe that they adequately discussed the case and the learning issues. At the conclusion of each case, there was a meeting of all students in which the list of learning issues and references were agreed upon by all students. The facilitator then prepared the written examination based upon the above stated learning issues.

The facilitator's role throughout the case is to guide students back to the relevant learning issue when they stray, to ask leading and clarifying questions to maintain student focus on the stated learning issues, and to provide an enrichment lecture if one is deemed necessary, and finally, to guide the students through a subsequent laboratory session.

In the second semester of the junior year, the problem-based learning cases involve patients receiving intensive care with most of these patients requiring mechanical ventilation. The cases are taught sequentially and students are expected to continually review previously learned concepts along with the new concepts.

The senior year consists of three specialty courses in: (1) cardiovascular diagnostics, (2) neonatal/pediatrics, and (3) subacute care. Each of these incorporates a problem-based learning and a clinical component. These classes met twice a week as opposed to the junior classes which met three times per week. Students benefited from the extra time as they were able to identify their learning issues more quickly and thus, were able to utilize library resources more effectively (Adapted from Op't Holt, 2000).

### Procedures

In the fall of 1998, the faculty at the University of South Alabama implemented a problem-based learning curriculum in the baccalaureate respiratory therapy program in response to both internal (O'Daniel et al., 1992) and external (Finocchio & Johnson, 1995) needs of the profession. After conducting a nationwide search, the researcher identified the Respiratory Therapy Program at the University of South Alabama as one program that specifically had designed and implemented a problem-based learning curriculum before the year 2000. A letter of intent to participate in the study was sent to the program director. The letter described both the purpose



and the benefits of the study. Permission was granted by Dr. Tim Op't Holt, Program Director of the University of South Alabama Cardiorespiratory Care (Appendix A). An expedited approval from the Seton Hall Institutional Review Board (IRB) (Appendix B) was obtained. Students' decision-making scores from the NBRC Clinical Simulation self-assessment exams and the actual graduate exam scores were obtained from the program during the years 1996-2003. The scores from the four year time frame of 1996-1999, which represented the traditional curriculum, were then compared with the time frame of 2000-2003, which represents the problem-based learning curriculum.

The program consented to participate in the study in July of 2004 (Appendix A). The program secretary compiled all the data necessary for the study into an excel spreadsheet. The demographic data, such as students' GPA on admission and exit from the program, sex, age, ethnicity, highest earned degree, and the area where they lived, was obtained along with students' decision- making scores from both the self-assessment exams and the actual score from the NBRC exam post graduation. Student anonymity was maintained by coding students' initials with the respective graduation year.

### Instrumentation

Prior to graduation from the respiratory therapy program, students take several self-assessment exams that are purchased from the national testing agency for respiratory therapy known as The National Board for Respiratory Care. Respiratory therapy programs utilize the results from these exams for

outcome assessment data. These exams are developed in the same manner as the actual exam that students take upon graduation from a respiratory therapy program. The exam provides two scores for the student, information gathering and decision making for each of the ten problems. The respiratory therapy program recommends that the student take these exit exams without studying for them to provide a true self-assessment of the knowledge base prior to exiting the program. Students can then utilize this information to prepare for their actual NBRC board exams upon graduation.

The students' individual decision-making scores from the NBRC Clinical Simulation Exam were selected for several reasons. First, the Clinical Simulation Exams from the NBRC are considered by experts in philosophy and the social sciences to be one of the few domain-specific instruments for the assessment of critical thinking (Mishoe & Dennison, 1997). Two studies thus far in the field of Respiratory Therapy support the hypothesis that decision-making scores positively correlate with critical thinking skills. Mishoe & Dennison (1997), found a significant correlation ( $r = 0.34$ ) between critical thinking scores and decision-making scores. They found that students with greater critical thinking abilities could be expected to perform better on the clinical simulation exams. Hill (2002) found a significant correlation between critical thinking scores and decision-making scores for 110 students completing the NBRC Clinical Simulation Exam ( $r = 0.32$ ,  $p < 0.01$ ). Second, since Respiratory Therapy Programs utilize the NBRC exams prior to students exiting from the program, and once they graduate for outcome

assessment, these scores were easy to obtain from the University of South Alabama.

The Clinical Simulation Self-Assessment Examination is one of three exams that are administered by the National Board for Respiratory Care. This exam consists of 10 patient management problems where the student must gather information about a patient problem, interpret the results of that data, and then make the appropriate clinical treatment decisions based upon all the information. Two scores are obtained from this exam, information gathering and decision-making. Students receive immediate feedback on the decisions they have made, and use that feedback when making each subsequent decision. The exam is computer based and takes four hours to complete. Upon graduation, students can take the Clinical Simulation Exam after completion of two other board exams offered by the NBRC. Participation in this exam is voluntary, but is recommended by all programs for student success in their field.

### Data Analysis

The data was analyzed using the Pearson product-moment correlation coefficient to describe the relationship between decision-making scores and problem-based learning from students in the traditional curriculum versus after the intervention of the problem-based learning curriculum. This statistical test was chosen due to its ability to measure the strength of

association between two variables that are on the interval or ratio scales (Portney & Watkins, 1993). Furthermore, this measure was chosen because it can be used for paired observations for the same set of individuals, and the size of the sample does not affect the size of the correlation coefficient.

The t-test for independent samples was also used to determine the strength of the relationship between the independent variable, which is type of curriculum, and the dependent variable, which is decision-making scores. This study is a relational design, therefore causation cannot be concluded due to the lack of a true experimental design (Portney & Watkins, 1993). Levene's test for equality of variances was also conducted due to the low sample number ( $n = 14$ ) for the actual graduate exam scores who participated in the problem-based learning curriculum. The percentages of students passing the exams for both the self-assessment and the actual decision-making scores were also calculated and reported.

## Chapter IV

### RESULTS

#### Demographics

The total number of participants in the study was  $n = 100$ . The number of participants in the traditional curriculum  $n = 60$  and the number of participants in the problem-based learning curriculum  $= 40$ . The number of students who took the actual NBRC exam post graduation from the program was  $n = 58$ . Of those 58,  $n = 44$  were from the traditional curriculum and  $n = 14$  were from the problem-based learning curriculum. Of the 100 participants, 37% were male and 63% were female. The average age of the participants was 22.76 with 62% of students with the age of 22 or younger, another 23% with the age of 23-25, and 15% over the age of 25. 91% of the participants were from the Southeast area of the country (which included Alabama, Florida, and Mississippi). 71% of the participants were White, 17% were Black, 7% were Asian, and 5% were of other ethnicities. The mean of the GPA on admission  $= 2.96$  and the mean of the GPA on exit  $= 3.04$ . Both means were analyzed with the self-assessment exams and the actual exam scores, however, there were no significant differences between the two so they were excluded from further analysis. All the participants had a bachelor's degree as the highest degree earned.

Pearson-product moment correlations were calculated for the actual NBRC exam decision-making scores, the NBRC self-assessment scores and the type of program traditional or problem-based. In addition, the self-assessment exam scores were correlated with the actual NBRC exam decision-making scores. One correlation was found at the  $p < .05$  level of significance. The self-assessment decision-making scores and the actual NBRC exam decision-making scores had a positive correlation of ( $r = .342, p < .01$ ). This means that the students that scored higher on the self-assessment exams generally scored higher on the actual NBRC exam as well. The self assessment decision-making scores and the type of curriculum had a moderate positive correlation ( $r = .216, p < .05$ ) with the traditional curriculum coded as 1 and the problem-based learning curriculum coded as 2. The type of curriculum was coded this way due to the fact that they are nominal variables. This finding demonstrated that exam scores for the problem-based learning curriculum were much higher than the traditional curriculum. The NBRC actual exam decision-making scores and the problem-based learning curriculum had a high positive correlation of ( $r = .583, p < .01$ ). This finding demonstrated that students from the problem-based learning curriculum scored higher on the NBRC actual exam than students in the traditional curriculum. The Pearson product-moment correlation coefficients for the three correlations and the decision-making scores and the type of curriculum are shown in Table 1.

Table 1

Pearson-Product Moment Correlation Coefficients for Exam Decision-Making Scores and the Type of Curriculum

Variables	Correlation Coefficient
SAE DM Score and Curriculum	.216*
Actual Exam DM Score/SAE DM Score and Curriculum	.342**
Exam DM score and Curriculum	.583**

\*\* Correlation is significant at the 0.01 level (2 tailed)

\* Correlation is significant at the 0.05 level (2 tailed)

Note: Correlation between independent variable which is type of curriculum and the dependent variable which is DM scores

The t-test for independent samples was also performed to compare the means of the problem-based learning curriculum with the traditional curriculum decision-making scores for both the actual NBRC exam and the self-assessment exam. The minimum passing decision-making score for the exam was 79. For the actual exam the range was from (63-67) depending on the year taken. There was a significant difference in self-assessment scores by type of curriculum. Students in the problem-based learning curriculum ( $M = 87.23$ ) scored 10 points higher on the self-assessment exam decision-making scores than student in the traditional curriculum ( $M = 77.18$ ). There was a significant difference in the actual NBRC exam decision-making scores by type of curriculum. Students in the problem-based learning curriculum ( $M = 108.71$ ) scored 27 points higher on the actual NBRC exam decision-making scores than students in the traditional curriculum ( $M = 81.07$ ). This means that the problem-based learning curriculum was associated with higher scores. The mean scores and standard deviations are presented in Figure 2. The Independent t-test results are presented in Table 3.



Figure 2

Comparison of Mean Decision-Making Exam Scores by Type of Curriculum  
and Type of Exam

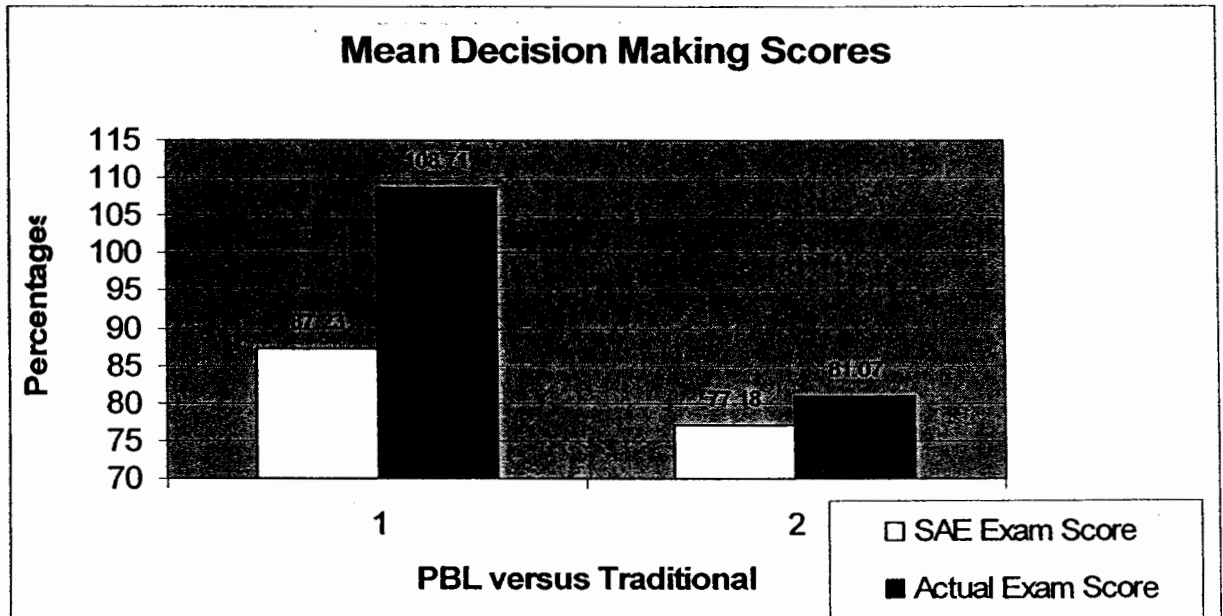


Table 3

Independent Samples T Test Results

	<i>t</i>	<i>df</i>	<i>Sig.</i>	<i>Mean Difference</i>	<i>P</i>
SAE Exam DM Score	2.186	98	.031	10.04	< .05
Actual Exam DM Score	7.928	52.11	.000	27.65	< .01

The Levene's test for equality of variances was performed as a standard procedure for independent samples t-test. Despite a significant finding for inequality of variance, there is still a significant mean difference in exam decision-making scores by type of curriculum.

The percent of students passing the self-assessment exam in the traditional curriculum was 53% as compared to 68% for the students in the problem-based learning curriculum. This was a significant finding as well and is reported in Table 4.

Table 4

Percent of Students Passing Self-Assessment Exam by Type of Curriculum

Program	<u>n</u>	%
Traditional	60	53%
Problem-based Learning	40	68%

## Chapter V

### DISCUSSION

The purpose of this study was to examine the effectiveness of problem-based learning teaching strategies on the decision-making skills among two groups of baccalaureate respiratory therapy students who were exposed to a traditional learning curriculum and a problem-based learning curriculum between the years 1996-2003. Students' decision-making scores from the NBRC Clinical Simulation Self-Assessment Exam and the actual NBRC Clinical Simulation exam scores post graduation were analyzed. Analysis of the data revealed statistically significant positive differences in exam scores by type of curriculum. Decision-making scores on the NBRC Clinical Simulation Self-Assessment Exam and the graduates' actual exam scores demonstrated a steady increase in mean scores for the students in the problem-based learning curriculum. The percentage of students passing the NBRC Clinical Simulation self-assessment exam was 68% for the problem-based learning curriculum as compared to 53% for the traditional curriculum. GPA on both admission and exit shared no relationship with the self-assessment exam scores or the actual exam scores and therefore, was excluded from further analysis. Gender, ethnicity, and age were not related to the self-assessment and the actual exam scores and were also excluded from further analysis.

### The Research Question

The problem addressed in the present study is one of the current challenges faced by respiratory therapy educators nationwide. Hill (2002) states that the continuing evolution of the respiratory care profession requires that every respiratory therapist demonstrate an advanced level of critical thinking, assessment and problem solving skills. Therefore, if respiratory therapy educators can utilize new pedagogies that are designed to improve students' decision-making skills, then their graduates can be better prepared to meet the future demands of the profession. Statistically significant positive differences in exam decision-making scores by type of curriculum were demonstrated by the subjects in this study and support the findings by Mishoe et. al (1997) and Op't Holt (2000) regarding the use of problem-based learning in respiratory care. The outcomes in this study also support other studies in both the medical and dental arenas (Vernon and Blake, 1993; Login et. al 1997; Shuler and Fincham, 1998). The outcomes also reveal that problem-based learning does improve decision-making skills in respiratory therapy students. Finally, the outcomes raise implications for respiratory therapy education in general.

The rationale for focusing on improving students' decision-making skill is based upon the hypothesis that a positive relationship exists between decision-making and critical thinking as measured by the Watson-Glaser Critical Thinking Appraisal Test (Mishoe et al. 1997; Hill 2002). The findings in this study support the hypothesis that there is a statistically significant

positive change in students' decision-making scores on the NBRC Clinical Simulation Exam after completion of a baccalaureate respiratory therapy program, which utilizes a problem-based learning curriculum as compared to students' decision-making scores from the traditional curriculum. This also provides the answer to the research question: for example, that a significant positive relationship exists between students' decision-making scores on both the Clinical Simulation self-assessment exams and the actual exams given by the National Board For Respiratory Care Exam for graduates of the problem-based learning curriculum at the University of South Alabama Respiratory Therapy Program when compared to the traditional curriculum.

#### GPA

The GPA on both admission and exit shared no relationship with the self-assessment exam scores or the actual exam scores and was therefore excluded from further analysis. These results are in contrast to the findings of the study by Mishoe et al, (1997) and Hill (2002). These studies found a significant relationship between GPA and critical thinking scores and thus postulated that students with higher GPA's can be expected to perform better on the self-assessment and the actual NBRC Clinical Simulation Exams. However, this outcome is expected due to the nature of the NBRC Clinical Simulation Exam. It requires a strong background in discipline-specific content and therapeutic processes (Hill 2002) which usually correlates with a students' high academic performance.

### Problem-Based Learning

This study showed a statistically significant difference between the self-assessment decision-making scores and the actual NBRC exam decision-making scores had a positive correlation of ( $r = .342, p < .01$ ). This means that the students that scored higher on the self-assessment exams generally scored higher on the actual NBRC exam as well. The self assessment decision-making scores and the type of curriculum had a moderate positive correlation ( $r = .216, p < .05$ ). This finding demonstrated that exam decision-making scores for the problem-based learning curriculum were much higher than the traditional curriculum. The NBRC actual exam decision-making scores and the problem-based learning curriculum had a high positive correlation of ( $r = .583, p < .01$ ). This finding demonstrated that students from the problem-based learning curriculum scored higher on the NBRC actual exam than students in the traditional curriculum.

The results of this compare favorably to studies previously mentioned in Dental education regarding problem-based learning which utilized a standardized performance measure. Two similar studies (Shuler and Fincham, 1998; Login et al., 1997) demonstrated that problem-based learning students scored significantly higher than the traditional track students on national dental exams. The students' ability to perform better on a standardized examination may be related to the differences in pedagogy used to convey the curricular material (Shuler and Fincham, 1998). This demonstrates the students' ability to self-evaluate their learning and not only



work independently but also fosters improved cooperative group efforts to provide students with the skills they need to be successful practitioners. Login et al (1997) also found that dental students who participated in the problem-based learning curriculum were able to independently organize their information and demonstrated higher levels of understanding of the material as recognized in their oral presentations and discussions. These are vital skills that are necessary for today's competent and caring respiratory therapists.

Respiratory therapy educators can benefit from the results of this study in several ways. Since this study demonstrated that students' decision-making scores do change after completion of a specific class or curriculum designed to improve their decision making skills, then these strategies should be incorporated into the curriculum. In addition, Hill (2002) found that 40% of the respiratory therapy programs used problem-based learning as a strategy to develop critical thinking and decision-making skills. Respiratory therapy educators are constantly seeking new ways to improve the effectiveness of their programs, overall scores on the NBRC credentialing examinations, and to provide their students with the necessary skills they need to become successful practitioners. Other allied health educators can benefit also from these results to utilize this information to make the necessary curricular changes to benefit their students' educational outcomes. In addition to the raw data supported by problem-based learning, it has also been demonstrated to increase satisfaction for both students and faculty.

### Limitations

This study involved respiratory therapy students from only one education program. The program is a baccalaureate degree program that implemented a problem-based learning curriculum in 1998 in response to both internal and external changes in the profession. This was a complete curriculum change regarding the respiratory therapy classes. The protocol for the problem-based learning format follows very stringent guidelines. Both students and facilitators participate in ongoing assessments. Although there are other respiratory therapy programs that have implemented problem-based learning strategies, they may not be exactly alike, nor can one control for how the facilitators are trained, the strategy implemented or how the students are assessed. The sample of graduates that took the actual NBRC Clinical Simulation Exam from the problem-based learning curriculum (n = 14) was markedly smaller than the sample of graduates for the traditional curriculum (n = 44). However, despite the small sample (n = 14) for the graduates from the problem-based learning curriculum who took the actual NBRC Clinical Simulation exam, their results were 27 points higher than the students in the traditional curriculum (n = 44). This imbalance represents a phenomenon that is affecting all respiratory therapy programs nationwide. Several reasons for the small number of students taking this exam after graduation are due to the lack of incentives provided by their employers to take the exam, overall personal incentives; such as, it is not required in order to practice as a respiratory therapist and finally the cost is high in comparison to the salary

benefit. In addition, data provided by the (CoARC) Committee on Accreditation for Respiratory Care (R. Walker, personal communication, December 15, 2005) have demonstrated a steady decline nationwide in the number of total graduates versus the number of graduates taking and passing the NBRC Clinical Simulation exam. However, it is imperative that the graduates of our programs possess strong decision-making abilities and that they demonstrate these skills by earning the RRT credential which represents the “standard of excellence” for the profession, as outlined by the essentials for accreditation of respiratory therapist education programs (CoARC 2000).

## Chapter VI

### SUMMARY AND CONCLUSIONS

Mean decision-making scores by type of curriculum steadily increased in the respiratory therapy students who participated in this study. There was a strong correlation ( $r = 0.58$ ) found for exam decision-making scores and the problem-based learning curriculum. The percent of students passing the NBRC Clinical Simulation self-assessment exam was 68% for students in the problem-based learning curriculum as compared to 53% for students in the traditional curriculum. These results compare with two similar studies; (Shuler and Fincham, 1998; Login et al. 1997) which demonstrated that problem-based learning students scored significantly higher than the traditional track students on national dental exams. In addition, these results further exemplify the initial evaluation of the respiratory therapy program at the target University (Op't Holt, 2000). The program uses the results of these exams as indicators of the success of the problem-based learning method. The results of this study imply that problem based learning has a significant positive impact on decision-making skills in respiratory therapy students.

The relatively recent introduction of problem-based learning curricula into respiratory therapy education, the small number of problem-based learning programs to study, the method by which the pedagogy is being utilized and the small number of graduates who actually take the NBRC

Clinical Simulation Exam make it difficult to study. Despite the small number of participants in this study, the design demonstrated that the problem-based learning curriculum had a significant positive impact on decision-making skills in respiratory therapy students. It is difficult to imply cause-and-effect as an experimental design was not utilized. Further research should be conducted to increase the literature available to guide educators in utilizing the problem-based learning method in respiratory therapy students; whether it is a total curriculum change, into several classes or a single class approach. An additional suggestion for further research would involve a larger study that incorporates multiple respiratory therapy programs utilizing a longitudinal design to compare and contrast the effects of the problem-based learning pedagogy on the students' decision-making scores on the NBRC Clinical Simulation Exams and their overall scores on all the other NBRC board exams as well.

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## DEFINITION OF TERMS

**CoARC:** The Committee on Accreditation for Respiratory Care. This committee reviews Respiratory Therapy programs through yearly annual reports and for program evaluation every ten years.

**NBRC:** The National Board for Respiratory Care. The National testing agency for Respiratory Therapy Programs.

Appendix A

UNIVERSITY OF SOUTH ALABAMA

DEPARTMENT OF  
CARDIORESPIRATORY CARE



1504 SPRINGHILL AVENUE  
MOBILE, ALABAMA 36604-3273  
TELEPHONE: (251) 434-3405  
FAX: (251) 434-3941

July 27, 2004

Amy Ceconi  
6 Hoey Cir.  
Pomona, NY 10970

Dear Amy,

This letter is to inform you and your committee that the Department of Cardiorespiratory Care at the University of South Alabama will participate in your doctoral dissertation study of the outcomes of Problem-Based Learning.

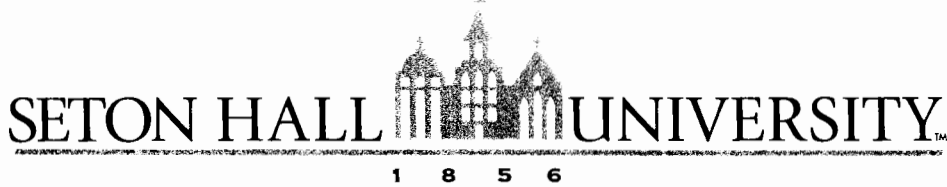
We understand that you will request the cooperation of the NBRC in obtaining our graduates' scores on the clinical simulation examination, and that the scores will be sent to us for forwarding to you anonymously. You may contact our secretary Deanna Winn and me to facilitate the study.

Sincerely,

A handwritten signature in cursive script that reads "Tim Op't Holt".

Tim Op't Holt, Ed.D., R.R.T, AE-C, F.A.A.R.C.  
Professor

**Appendix B**



**REQUEST FOR APPROVAL OF RESEARCH, DEMONSTRATION OR RELATED ACTIVITIES INVOLVING HUMAN SUBJECTS**

All material must be typed.

PROJECT TITLE: A Comparative Study on Problem Based Learning in a Respiratory Therapy Program.

**CERTIFICATION STATEMENT:**

In making this application, I (we) certify that I (we) have read and understand the University's policies and procedures governing research, development, and related activities involving human subjects. I (we) shall comply with the letter and spirit of those policies. I (we) further acknowledge my (our) obligation to (1) obtain written approval of significant deviations from the originally-approved protocol BEFORE making those deviations, and (2) report immediately all adverse effects of the study on the subjects to the Director of the Institutional Review Board, Seton Hall University, South Orange, NJ 07079.

Amy Ceconi Dr. Genevieve Pinto-Zipp and Dr. Valerie Olson

September 28, 2004

RESEARCHER(S) OR PROJECT DIRECTOR(S)

DATE

**\*\*Please print or type out names of all researchers below signature. Use separate sheet of paper, if necessary.\*\***

My signature indicates that I have reviewed the attached materials and consider them to meet IRB standards.

Genevieve Pinto Zipp, Ph.D.  
RESEARCHER'S ADVISOR OR DEPARTMENTAL SUPERVISOR

10-4-04  
DATE

**\*\*Please print or type out name below signature\*\***

The request for approval submitted by the above researcher(s) was considered by the IRB for Research Involving Human Subjects Research at the Oct 104 meeting.

The application was approved  not approved  by the Committee. Special conditions were  were not  set by the IRB. (Any special conditions are described on the reverse side.)

Mary J. Ruzicka, Ph.D.  
DIRECTOR,  
SETON HALL UNIVERSITY INSTITUTIONAL  
REVIEW BOARD FOR HUMAN SUBJECTS RESEARCH

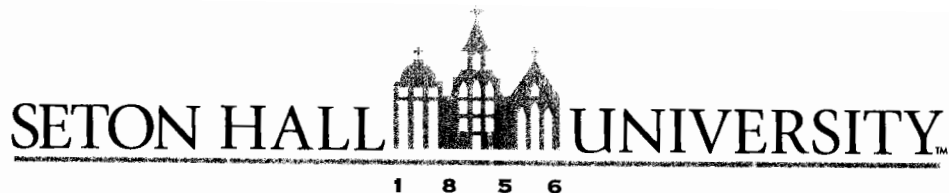
10/26/04  
DATE

400 South Orange Avenue • South Orange, New Jersey 07079-2689

Seton Hall University  
05/2004



## Appendix C



September 7, 2005

Amy Ceconi  
6 Hoey Circle  
Pomona, New York 10970

Dear Ms. Ceconi,

The Seton Hall University Institutional Review Board has reviewed your Continuing Review application for your research proposal entitled "A Comparative Study on Problem Based Learning in a Respiratory Therapy Program".

You are hereby granted another 12-month approval from the date of this notice. If any changes are desired in this protocol, they must be submitted to the IRB for approval before implementation.

Thank you for your cooperation.

Sincerely,

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

cc Dr. Genevieve Pinto-Zipp  
Dr. Valerie Olson

Office of Institutional Review Board  
Presidents Hall  
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