Beliefs and Practices of Expert Respiratory Care Faculty on Critical-Thinking Learning: a Case Study

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ABSTRACT

BELIEFS AND PRACTICES OF EXPERT RESPIRATORY CARE
FACULTY ON CRITICAL-THINKING LEARNING:
A CASE STUDY

By

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Title: BELIEFS AND PRACTICES OF EXPERT RESPIRATORY CARE FACULTY ON CRITICAL-THINKING LEARNING: A CASE STUDY

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Problem

The development of critical-thinking skills during the professional training of respiratory therapists is imperative for good practice. Research evidence suggests that interactive instructional strategies are far more effective than traditional lectures. Missing from the literature are thick descriptions of how faculty organize the delivery of respiratory therapy curriculum to develop critical thinking. This case study describes the beliefs and practices of faculty members in an academically strong program in view of developing critical thinking.
Method

A qualitative, single case-study design was used to identify critical-thinking strategies and beliefs incorporated by the faculty. The program was nominated by expert members of the Committee on Accreditation for Respiratory Care. Qualitative data were collected from classroom observations, program and syllabi documents, and audiotaped interviews with administrators and faculty. These data were analyzed and represented in a metaphor and a mathematical model.

Results

The analysis revealed three major themes: (a) The faculty believe critical thinking is developed by motivating students to learn by doing; (b) a variety of educational strategies and techniques were used to involve students in active learning; and (c) essential programmatic characteristics support the development of critical thinking.

This research identified ways that faculty motivate students to become effective critical thinkers. Faculty passion is an important student motivator. Tying clinical experiences to classroom instruction also motivates students. Students are further motivated when they recognize competent faculty with well-planned curricula.

The faculty believe the best teaching strategies involve the students in “learn by doing” activities that keep the students from developing an excessive dependence on them for learning. “Learn by doing” activities include: Problem-based learning and techniques philosophically consistent with cooperative learning such as presentations in class, organizing and providing peer teaching, peer evaluation, and classroom discourse.
The faculty provide an extensive orientation to clarify student and faculty roles during the initial problem-based learning course.

The development of critical thinking is enhanced when program characteristics include adequate numbers of faculty so that optimal faculty-to-student learning ratios are achieved in crucial curriculum areas. The faculty maintained that college instructors should hold a graduate degree. In addition, faculty value substantial program prerequisites and high admissions standards. They do not leave student preparation for credentialing examinations to chance and require the regular passage of comprehensive examinations over the previous quarter’s work. The role of the student and faculty in the development of critical thinking is represented metaphorically in a mathematical equation that describes the relationship between factors that govern nutrient exchange where mother and child meet in the placenta.

Conclusions

The development of critical thinking results from the successful implementation of sound beliefs. An effective respiratory therapy learning environment has key features that correlate with those described by social learning theorists as occurring in the zone of proximal development. In addition to learn-by-doing strategies and techniques, faculty must focus on the motivation that faculty supply as role models and program characteristics.
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A CASE STUDY

A Dissertation
Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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To all who inspire and
to Linda,
with love and gratitude
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CHAPTER 1

INTRODUCTION

Critical thinking is imperative for respiratory therapists who are responsible for making quick and crucial decisions regarding patient care under stressful conditions. They must use professional judgment not only to determine patient needs but also to communicate vital information to family and health-care colleagues. A respiratory therapist may be called to the bed of a patient whose breathing tube is completely blocked off. The therapist would not only need to identify the problem, but also communicate the rationale for removing the artificial airway. The three United States-based professional organizations charged with governance and direction of respiratory care produced the following tripartite statement: 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” (Traband, Hiser, & Gallo, 2003, p. 33). This statement demonstrates the importance that critical thinking is now being given within the respiratory care profession.

As the program director of a respiratory care program, I share the concern of my colleagues and professional organization that critical thinking is prioritized in respiratory care training. It is vital both at the patient’s bedside and in the setting of the national clinical simulation examination. To help the therapists develop these critical skills, respiratory therapy training programs and faculty must be preparing candidates to
do critical-thinking. This case study examines one university’s program that effectively uses strategies and faculty culture to help candidates develop these critical-thinking skills.

This chapter provides an introduction to the concept of critical thinking particularly as it relates to respiratory care education, and also provides an overview of my research on the beliefs of expert respiratory care faculty on the development of critical-thinking learning strategies.

**Background of the Problem**

While critical thinking is a construct many scholars have defined in various ways, Ennis (1996) provides a particularly relevant definition that fits well with the practice of respiratory care: “Critical thinking is a process, the goal of which is to make reasonable decisions about what to believe and what to do” (p. xvii). Respiratory care is a highly collaborative profession, practiced under the medical direction of physicians and in collaboration with nursing. Because of the nature of the job, the critical thoughts of respiratory therapists are most effective when they are developed and shared with other professionals. In respiratory care, practical elements of critical thinking include coherently voicing thoughts and carefully listening to others in order to find the best solutions to immediate problems (Mishoe, 1995).

While the collaborative aspect of critical thinking applies in other settings as well, these skills are particularly needed in respiratory care because of the migratory nature of the profession. In many jobs, individuals work with the same set of people every day and get to know them well, enabling them to create a strong team dynamic. Respiratory therapists work in a variety of settings, often with complete strangers. It is
not uncommon for a single respiratory therapist to work on the medical surgical floor, in the intensive care unit, the emergency room, the delivery room, and the nursery in a single day. The respiratory therapist with underdeveloped critical-thinking skills merely looks busy moving from unit to unit, performing tasks while not effecting needed changes in response to evolving patient dynamics. The respiratory therapist with well-developed critical-thinking skills is able to move into each area and quickly create rapport with clinicians, successfully co-managing patient care. The ability to move between groups of professionals while communicating patient evaluations and facilitating decisions to direct cardiopulmonary care is a particularly important element that critical-thinking helps to foster.

The realization of the importance of critical thinking in respiratory care is relatively recent. Historically, inhalation therapists and respiratory technician training emphasized the operation of equipment. Physicians gave the orders directing care, and respiratory therapists simply carried those orders out. Since the late 1980s, respiratory care practitioners have become increasingly responsible for crucial decisions determining the course of patient care. According to the American Society of Anesthesiologists (1996), Respiratory Care Practitioners (RCPs) “undergo unique and rigorous formalized training. The patients under their care frequently include a disproportionately sicker population than is the case for most other allied health practitioners” (p. 1).

Respiratory therapists deal with complex and life-threatening conditions. They must initiate, conduct, and modify care that includes the treatment of a tension pneumothorax, one of the most lethal of critical care emergencies. This is an acute
injury in which a tear or hole in the breathing tubes causes air to escape from the lungs, entering the chest cavity. During each attempted breath, more air enters this cavity and cannot escape, resulting in the buildup of high pressure. Tension on the heart and blood vessels prevent the circulation of blood through the chest and to the body. Patients tend to panic because they cannot breathe, and often fight or “buck” the ventilator (Tobin, 1991). If this continues for more than a few minutes, the result is certain death. To treat this condition, the respiratory therapist, along with the intensive care nurse or physician, needs to act quickly, determining the point at which needle decompression is necessary. The therapist must have the ability to retrieve information from his or her memory under stress in order to deal with these kinds of life-threatening situations.

Thinking critically requires information on which to base good decisions. Logic tells us that we must know important facts in order to determine the best life-saving interventions. Respiratory care graduates must, therefore, be able to retrieve vital information during a crisis in order to think critically. The failure to recall information in the context for which it should be applied is inert knowledge. Whitehead (as cited in Bransford & Vye, 1989) made the sobering claim that schools are especially good at producing inert knowledge as opposed to useful knowledge, and subsequent research has verified the existence of this problem. The reliance on lectures as a mode of instruction is partly responsible for producing inert knowledge. Still, many respiratory care educators have not made the transition away from lecture-based instruction (Hopper, 2002; Mishoe, 1993; Op't Holt, 1994). Those who try more student-centered techniques are often met with resistance or conflict (Lenburg, 1999, p. 11; Mishoe,
2002) from the students, who initially struggle to adapt to the kind of active learning that promotes critical thinking.

In the context of respiratory therapy, inert knowledge can be devastating. A respiratory therapist unable to remember the steps necessary in the management of sudden distress in a ventilator-supported patient may respond inappropriately, delaying definitive care. Such a delay could result in death or profound brain damage.

The respiratory care profession recognizes the importance of the educational community and faculty as a resource supporting the development of critical thinking. This is illustrated in the following portions of the tripartite statement by the professional respiratory organizations: “We strongly support faculty development activities specific to educational methodology. We support the development of baccalaureate and graduate education in respiratory care and encourage respiratory therapists to pursue advanced levels of education” (Traband et al., 2003, p. 33). If respiratory care is going to produce therapists able to function appropriately, its faculty must be knowledgeable regarding the means to this end. Clinical and technical proficiencies alone are inadequate qualifications for respiratory care faculty. Faculty must know what is needed to develop critical thinking. Hill (2002) highlights this need, recommending that further research be conducted in order to improve the foundations of evidence available to guide educators in developing critical thinking and decision-making skills in respiratory care students. More recently, Beachy (2004, p. 114) recommended the development of an outline of the optimal conditions under which each educational mechanism operates most effectively. A comprehensive description of the optimal educational conditions needed to develop critical thinking remains a research challenge within respiratory care.
The adoption of critical-thinking-based approaches represents a difficult shift for both faculty and students. Students experience a great deal of tension when they transition from a passive approach of learning to problem-based learning (DeMarco, Hayward, & Lynch, 2002, p. 167), which is key to developing critical-thinking skills. Students accustomed to writing notes and memorizing facts to pass examinations will find differentiating between the plausibility of arguments a challenge for which they are unprepared. Likewise, faculty find a significant challenge when moving from teaching and testing right and wrong answers to teaching and testing thinking processes.

**Statement of the Problem**

The development of critical-thinking skills during the professional training of respiratory therapists is imperative for good practice. Research evidence suggests that interactive instructional strategies are far more effective than traditional lectures. Missing from the literature are thick descriptions of how faculty organize the delivery of respiratory therapy curriculum to develop critical thinking. The focus of this study is the development of critical thinking in respiratory care training.

**Purpose of the Study**

The purpose of this case study was to describe the beliefs and educational strategies currently used to develop critical thinking in an academically strong respiratory care program.

**Research Questions**

What do expert faculty in a strong respiratory care training program believe concerning the development of critical thinking? How are particular learning strategies...
consistently implemented by expert respiratory care educators to enhance critical-thinking and problem-solving skills in their students? Which program components best support the development of critical thinking?

**Methodology**

I used a qualitative, single case study design to identify critical-thinking strategies incorporated by the faculty into a strong program. The program was nominated by expert members of the Committee on Accreditation for Respiratory Care. Qualitative data were collected from classroom observation, program documents, and audiotaped interviews with administrators, faculty, and students. These data were analyzed and represented in a metaphor and a mathematical model.

**Theoretical Framework**

This case study is viewed from the perspective of social learning theory, established by Albert Bandura (1977). As with other adult learners, respiratory care students are expected to influence their own thinking, as well as that of others, through social learning. According to Bandura, learning is a function of the individual interacting within an environment. In the environment students are said to learn vicariously by observing the actions of others (Bandura, 1970, p. 167; Merriam & Caffarella, 1999, p. 258). Bandura’s research (1970, p. 123) demonstrated that less learning occurs simply from observing modeled behavior. More learning occurs from modeled behavior when motivational variables are present and when there has been prior training in discrimination and the anticipation of positive and negative reinforcement.
In harmony with social learning theory, Freire (2005, p. 92) recognized that learning takes place in a social network, and that social dialogue is particularly important in “generating critical thinking.” And according to Vygotsky (1978, p. 90), learning occurs only through interaction with people and in cooperation with peers. Learning to think critically in some activities may be tiresome and uninteresting until the individual develops proficiency. Social learning theory (Bandura, 1977, p. 104) stipulates that in these areas social reinforcement is important in encouraging the participation necessary to develop proficiency. Respiratory care students benefit from activities in which they learn as a group, both to help them through the monotonous activities required for proficiency, and for learning how to behave in critical care situations. Learning with peers also allows them to perform at a higher level than they could alone. When students perform at a higher level with others they are said to be learning in the zone of proximal development (Vygotsky, 1978, p. 87). This interaction prepares them to successfully navigate highly interactive roles after graduation.

Bandura (1970) reported the increased adoption of modeled behavior when children watched attentively and verbalized responses (p. 134) and when the models were vivid and novel (p. 136). This kind of social observation and learning may occur in academic discourse. When students observe classmates and faculty learning and finding success through a process in which they eagerly and openly explore ideas, they too will adopt similar behaviors. Discourse is a conscientious effort to “validate contested beliefs and understandings” (Mezirow, 1999, p. 2) and this validation becomes the anticipated outcome (Bandura, 1970, p. 132) that results in the subsequent matching behaviors. In discourse, differences in knowledge and understanding are valued because their
exploration is seen as a means of improving the thinking of each participant.

Negotiating exactly this kind of communication is what respiratory therapists need to do successfully.

Because respiratory therapists think and work in a milieu of interactions with patients, family members, and other caregivers, it seems reasonable to suggest that educational strategies that include social interactions would be most effective in the developing of the kind of critical thinking that respiratory care students will eventually use in the workplace.

**Significance of the Study**

This case study offers specific ideas for respiratory care faculty, staff, and students as to how critical-thinking learning strategies are implemented in an academically strong program. The beliefs of expert faculty can be compared to one’s owns practice and belief. The reader can lift these views up and view them from their own perspectives. This process offers a potential to find or emphasize important keys to effective teaching. This case study describes the ideas of expert faculty about what is needed to make critical-thinking strategies effective. The examination of these ideas can provide an interesting method for faculty to use in developing and evolving their own thinking. This case study may also be useful for review by graduate students who are likely to be future respiratory care educators.

Students will benefit from this study as recipients of the practice of their instructors. When faculty gain knowledge and experiences in fostering critical thinking, students will enjoy better education. Practical strategies recommended for the development of critical thinking contain several elements supporting student motivation.
Such strategies may be organized in a way that provides what Brophy (1998) terms *relative autonomy*. Critical-thinking strategies may be employed in ways that provide optimal challenges and allow active involvement. Workers and students need activities that provide skill variety, task identity, task significance, and collaboration with peers (Brophy, 1998). More of these kinds of activities may be implemented as a result of this study. In addition to the improved development of thinking skills, students should experience greater satisfaction and motivation with the learning experience even though the initial shift may have been difficult.

Ultimately, this research may impact overall patient care. The reasons for our research and our educational practices must transcend the need for increased learning and motivation of faculty and students. An immeasurable objective, but nevertheless a mission of this research, is a reduction in the morbidity and mortality of the patients whom students and, ultimately, graduates serve.

**Assumptions**

My study assumes that essential and substantive information regarding how expert educators organize learning to develop critical thinking can be collected from a single program through one qualitative case study. It further assumes that recognized experts at a strong program in respiratory care education organize learning at a superior level, making them worthy of study.

**Delimitations**

This qualitative case study was delimited to one program nominated by respiratory care education and accreditation experts and members of the Committee on Accreditation for Respiratory Care.
Limitations

The qualitative case study is limited by the number of administration, faculty and students present during the on-campus visit. The qualitative case study is further limited by the number of classes that can be observed during the available time.

Definitions of Terms

Critical thinking (CT) is the “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990). As applied in respiratory care, critical thinking includes communicating and negotiating (Mishoe & Welch, 2002, p. 44). It also includes the ability of the clinician to help a group of professionals come to the safest and best patient care decisions.

Problem solving refers to the cognitive processes involved in achieving a goal, especially when the best way to achieve this goal is not immediately obvious (Wilson, Fernandez, & Hadaway, 1993, p. 1). In respiratory care practice this would include interpreting data after initiating a change. It would involve communicating one’s evaluation of whether the problem is closer to being solved as a result of the imposed change and then communicating the implementation of a subsequent change in response to new understandings.

Decision making is the cognitive processes used in judging, evaluating, choosing, selecting, picking, and resolving. In most cases of problem solving, some decision-making processes occur. However, problem solving involves generative processes whereas in decision making there are known alternatives (Butler, 2003) that
one must decide between. In respiratory care, decision making is usually done in consultation with other professionals.

*Inert knowledge* is knowledge that is not used by the individual in a place of logical application (Bransford & Vye, 1989, p. 188, Eisner, 1994, p. 205). A respiratory care student may learn about the laws governing artificial airways in the classroom but be unable to apply these laws in a clinical situation at the hospital.

*Educational technique* for the purpose of this study is a single teaching method thought to enhance learning. Calling on students in class is an example of a technique used to keep the student focused and interacting with the subject of the class.

*Educational strategy* is a “pattern of instructional effort” (Koepke, 1993, p. 11; Weissman, 1990) which consists of the arrangement of a number of teaching techniques. This recipe is thought to be synergistic when correctly implemented.

**Summary**

The development of critical thinkers in respiratory care is essential to quality health care. Strategies used to enhance critical-thinking are widespread, but practical insight into their successful implementation by expert faculty in respiratory care has been insufficiently described. This qualitative case study provides a description of the beliefs that faculty hold about critical-thinking and the ingredients these recognized experts consider important when implementing critical-thinking strategies.

Chapter 2 provides a review of literature about critical thinking in general and specifically in respiratory care. It also presents an overview of social learning theory as a framework for understanding the development of critical thinking in respiratory care. Chapter 3 contains a description of the methods used in this case study. Chapter 4
describes the data on the faculty’s beliefs and practices collected qualitatively at an expert respiratory care program. Chapter 5 proposes a metaphor and mathematical model to suggest how the program components and educational approaches necessary for the development of critical thinking are interrelated. Chapter 6 provides the discussion, recommendations and conclusions.
CHAPTER 2

LITERATURE ON CRITICAL THINKING

Introduction

This chapter reviews the timeless nature of critical-thinking concerns, the critical-thinking construct, and the teaching strategies used to develop critical-thinking and respiratory care research related to critical thinking. Finally the chapter offers aspects of social learning theory as a framework for understanding additional ingredients necessary for the development of critical thinking in respiratory care.

The Timeless Nature of Critical Thinking

A unique quality of human nature is that people are “constantly re-creating and transforming” (Freire, 2005, p. 99). Human creativity and intelligence are essential to our survival as social beings, since we lack the physical characteristics of claws, fur, feathers, and sharp teeth, as well as many instincts that help other species to survive. It is our ability to amass information, to model the abstract constructs of cause and effect in our minds, and to subsequently build what we imagined that has resulted in the technology that gives us an advantage in our environment and provides for our survival. It is the ability to use and communicate thought that allows our basic survival as well as the survival of our collaborative efforts. Our social institutions survive and compete through collective thought and superiority in communication. Essentially, both our individual
survival and the survival of our social institutions are dependent upon the care of our thinking and communication. This has been recognized for millennia and forms the basis for the perennial interest in education.

Solomon

The earliest records that we have of people recording advice about how to think and teach were from religious people who believed in one or more gods. Their writings were handed down, are currently studied, and have millions of followers today. King Solomon is an example of a wise man who wrote in 967 B.C.E. and whose writings have devotees in Christian, Jewish, and Islamic traditions today. Solomon recommended a proper attitude as a means of developing wisdom (Schoenberg, 2003). To be “wise” or to “have understanding” is the English translation of ancient terms whose definitions seem to overlap with what we are calling “critical thinking.” Solomon emphasized that the primary responsibility of the learner was to be enthusiastic in the pursuit of wisdom.

Solomon recorded his prescription:

Turning your ear to wisdom and applying your heart to understanding, and if you call out for insight and cry aloud for understanding, and if you look for it as for silver and search for it as for hidden treasure, then you will understand. . . . For wisdom will enter your heart. (Prov 2:2-5, 10 NIV)

Solomon is famous for finding unusual solutions to problems. The example in the Bible of Solomon’s wisdom is provided by his judicial testing. In the story, two harlots come to him both claiming to be the mother of an infant. When, however, Solomon gives the order to “divide the living child in two, and give half to the one and half to the other” the true mother cries: “Oh, my Lord, give her the living child, and by no means kill him.” But the second said, “He shall be neither mine nor yours; divide him!” Then the king answered and said, “Give the first woman the living child, and by no means kill him. She
is his mother” (1 Kgs 3:16-28). This example of the ability to dialogue in order to test other people’s positions with the purpose of establishing the most sensible course of action is a sound illustration of the kind of critical-thinking that this case study is about.

Socrates

Plato’s (427-347 B.C.) dialogues provide a record of what is known as the Socratic method (Stevenson & Haberman, 1998). Plato records the words of Socrates to depict the interaction between the master and the student. Described as the dialectic (Plato, 1937a/300 B.C.), the tutor provides a system through which the assumptions and framework whereupon the student thinks can be examined. In this examination, Socrates is portrayed as bringing forth the new idea as a midwife brings forth a baby.

The triumph of my art is in examining whether the thought which the mind of the young man is bringing to birth is a false idol or a noble and true creation. . . . Some of those who converse with me, at first appear to be absolutely dull, yet afterwards, as our acquaintance ripens, if the god is gracious to them, they all of them make astonishing progress; and this not only in their own opinion but in that of others. (Plato, 1937b/300 B.C.)

Socrates’ art is focused on creating true and noble thinking in the student. This art, which can result in astonishing progress, is the art of creating the dialectic. It is an exchange in which the basis for the student’s beliefs is patiently questioned and discussed, bringing the student to a greater understanding of her own perspective. The teacher may take the position of an opponent while questioning the student. This questioning leads the student to view and develop a nuanced understanding that would otherwise be unlikely.
Francis Bacon

Francis Bacon (1561-1626) wrote one of the first books (Bacon, 1952) on critical thinking. Bacon identified the first problem of learning as a preoccupation with reading books and insufficient investigation of matter itself (p. 12). He felt that the human mind was prone to believe whatever came most naturally. Beliefs that had not been subjected to careful investigation but resulted from prejudices or passion were called “idols” (p. 111). Bacon advocated pedantic knowledge acquisition that included the wise selection and timing of what should be taught, the progression from easier to more difficult topics, the allocation of topics specific to the “wits” of the students, and the effort to ensure that students not “exercise their faults” (p. 69) and therefore practice or develop bad habits.

René Descartes

After completing the full curriculum of languages, letters, logic, ethics, mathematics, physics, and metaphysics at the Jesuit School at La Fleche, Descartes (1596-1650) declared, “I found myself embarrassed with so many doubts and errors” (1952, p. ix). Years later Descartes proposed 21 rules for coming to knowledge by breaking down questions into simple elements which were then studied and represented in math-like expressions and geometric shapes. Descartes felt liberated by the logic of mathematics and modeled his method upon the pure means through which the “earliest pioneers of philosophy in bygone ages” established philosophy upon a “species of mathematics” (p. 6). He was also concerned enough about imagination and memory that he encapsulated the visual display of ideas in rule XV (Descartes, 1952, p. 33) for this purpose. The method described in Descarte’s rules appears to have helped to lay the foundation for the careful systematic methods used in scientific investigation today.
John Dewey

John Dewey (1859-1952), a pragmatic philosopher, illustrates the modern interest in the development of thinking. To Dewey (1939) thinking was not a mental process separate from the employment of objects, activity, or work. Dewey did not advocate thinking for the sake of thinking and he viewed the employment of thought to accomplish a tangible goal as an important motivating element.

To Dewey, two characteristics of successful teachers are that they study and understand their individual students and they understand the total atmosphere of learning. For example, Dewey (1939) writes, “The more a teacher is aware of the past experiences of students, of their hopes, desires, chief interests, the better will he understand the forces at work that need to be directed and utilized for the formation of reflective habits” (p. 615). To improve the process of “mere thinking” Dewey (1939, p. 843) recommends a reflective process that “involves running over various ideas, sorting them out, comparing one with another, trying to get one which will unite in itself the strength of two, searching for new points of view, developing new suggestions; guessing, suggesting, selecting, and rejecting.”

Both Solomon and Socrates are examples of the ancient concern for thinking among leaders who helped to establish conceptual frameworks and traditions that have lasted like the pyramids of Egypt until the present day. More recently Francis Bacon, Rene Descartes, and John Dewey emphasized a careful attitude, a systematic approach, and a connection between empiricism and scholarship as a means of developing thinking skills.
Critical-Thinking Construct

The critical-thinking construct is important to examine. The American Philosophical Association Delphi definition of critical thinking is the purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. . . . The ideal critical thinker is . . . prudent in making judgments, . . . orderly in complex matters, diligent in seeking relevant information. (Facione, 1990, p. 2)

This definition provides an expanded picture of what scholars mean when they use the term critical thinking. It is consistent with the definition provided by Ennis (1985, p. 45): “Critical thinking is reasonable, reflective thinking focused on what to believe or do.” However the Ennis definition emphasizes the need for critical thinking to involve a practical application. This is in line with the pragmatism of John Dewey. Critical thinking in the respiratory care context includes a specific interest in its practical applications in the clinical and academic context (Mishoe, 2003).

According to nursing scholar Duldt (1997), accreditation expectations require nursing faculty to develop their own definitions of critical thinking. Duldt recommends the above cited Delphi definition for consideration in this process. This recommendation lends credence to the generally recognized authority of the Delphi definition.

Respiratory care scholar Mishoe (1993) reported that the term “critical-thinking” had “become an omnipresent buzzword in educational writings” (p. 31). She proposed 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). Her research responded to the need to describe critical-thinking in a clinical setting rather than the campus of a college or university (Mishoe, 2003, p. 501). Her
earlier recommendations had been to look at the characteristics of a critical thinker (Mishoe, 1993, p. 32). Paul and Elder (2002) call these characteristics the traits of the disciplined mind, or intellectual virtues (p. 19). Mishoe’s (2003) research has identified the abilities that are demonstrated when respiratory therapy clinicians use critical thinking in clinical practice. These include the abilities to prioritize, anticipate, troubleshoot, communicate, negotiate, reflect, and make decisions (Mishoe, 2003, p. 500). Respiratory therapy scholars are concerned with these abilities whenever they speak or write about critical thinking.

Clinical critical thinking includes a constellation of contextual abilities, including communication skills, enabling one to individually and collectively solve problems, make decisions, and coordinate with others. The practice of health care involves the interactive and collective decision making of individuals from a variety of backgrounds. The decision of any single individual may be of little value if it is not made in conjunction with the patient and other clinical decision makers. The nurse, therapist, or patient may have a solution to a healthcare dilemma, but if that solution is not shared, with the relevance and weighted advantages adequately communicated, the solution may fail to be implemented. Repeated failures of this kind will be a source of frustration that may extinguish future communication attempts and lead to a less effective clinical team. Therefore, critical thinking is of no value in a clinical environment if it does not include effective communication.

**Educational Strategies for Critical Thinking**

Interest in critical-thinking learning strategies increased in the mid to late 1980s. During this time researchers identified successful instructional methods in critical
thinking. This section deals with the goals of critical-thinking strategies and examines two exemplary strategy examples: cooperative learning and problem-based learning.

The Goals of Critical-Thinking Strategies

Critical-thinking strategies aim to move students from passive learning to active involvement in the learning process (DeMarco et al., 2002, p. 165; Mishoe & Welch, 2002, p. 4). Students must practice self-regulation (K. J. Wood, 1998, p. 5). They are encouraged to reflect upon and identify their own critical-thinking processes (Greene, 2000, p. vi). This is a practice which will continue to enhance the proficiency of clinicians after graduation. As such, the student must be given practice in the autonomous interaction with others that will be required in the clinical context. Continuous rigid structure and inflexibility or a lack of interaction with others will prepare students to function merely as machines, unable to provide the necessary creative and abstract applications to real-life problems.

In contrast with traditional teaching, critical-thinking strategies do not “perpetuate the idea that there is only ONE correct answer and that the teacher is the expert who has all the answers” (Mishoe & Welch, 2002, p. 4). Critical-thinking strategies encourage interactive discussion of complex and controversial topics (Mishoe & Welch, 2002, p. 4). The instructor’s “task is to listen for what the group voice is saying and to play that voice back from time to time so the group can hear and even change its own collective mind” (Palmer, 1998, p. 76). This does not mean that the instructor never provides information. The approach used, however, does not assert finality or perfection, so the student is free to accept or reject the instructor’s information or point of view. The student is led to rationally analyze the basis upon which assertions are made, in order to accept or reject
any authoritative source. *Understanding by design* is said to occur as a result of cycles of questions and answers (Wiggins & McTighe, 1998). Such questions and answers are expected of all members of the learning circle as the means whereby one determines what to believe or do.

Successful critical-thinking learning strategies encourage active self-regulated learning, emphasize thinking processes over content, encourage interactive discussions, are domain specific, and concern themselves with complex, loosely defined problems that have multiple solutions. Faculty efforts are most successful when they focus their efforts on developing students’ competencies and talents (Johnson, Johnson, & Smith, 1991). These approaches contrast with the highly organized lecture approach (Hart, 1983). While this approach has the advantage of presenting large quantities of information in a logical way, the downside is the lack of student participation, which is key to developing good critical-thinking skills.

Critical-thinking pedagogies include *domain-specific* instruction, which is teaching occurring specifically within the practice of the profession (Ironside, 2003, p. 510; Mishoe & Welch, 2002, p. 514). Domain-specific instruction involves context-dependent problems, requiring a realistic, non-classroom-based setting (DeMarco et al., 2002, p. 165; Oermann, Truesdell, & Ziolkowski, 2000, p. 1). For example, respiratory therapists are likely to face many instances where they need to decide whether to increase or decrease oxygen flow to a patient. As students, they should be presented with these situations in a realistic environment, such as in a lab with a simulated patient. This will provide more assurance that the knowledge will not become inert, that is, only remembered in contexts that do not matter. Dewey might assert that thinking does not
occur at all outside an experiential context (Dewey, 1939). Thorndike (Vygotsky, 1978, pp. 82, 83) rejects the idea that learning in a formal discipline such as classical languages and mathematics results in a generalized ability that can be used in another dissimilar subject. Domain-specific learning should therefore include the specific settings and realistic problems of the profession that require critical thinking.

Two Exemplary Strategies

Two critical-thinking learning strategies are described as exemplary: *Cooperative learning* because it has a long and extensive research base (Ellis & Foutes, 1993) and *Problem-based learning*, because of its broad and strong advocacy among educators of physicians, nurses, allied health professionals, clinical psychologists, occupational therapists, physical therapists, and physician assistant programs (Mishoe, 1993, p. 33). Problem-based learning has also been strongly encouraged by respiratory care scholars (Mishoe & Welch, 2002; Op’t Holt, 1994, 2000). Cooperative learning provides other social learning activities (Johnson et al., 1991). These structures are described in the following sections.

**Cooperative Learning**

Cooperative learning is highly structured and focused on the task of learning. The cooperative process is considered to be supportive of the needs of students for productive relationships while it includes a kind of intellectual work that is different from lower order memorization (p. 12). For example, in respiratory therapy (Mishoe & Welch, 2002, p. 44) this different kind of intellectual work could include negotiation or shared thinking.
Cooperative learning (Johnson et al., 1991, p. 3:3) as a group of educational activities can be differentiated from group assignments and group work by the identification of specific qualities such as positive interdependence, individual accountability, heterogeneous membership, shared leadership, the emphasis of tasks and relationships, direct teaching of social skills, instructor intervening in groups, and group processing. Probably the most significant difference from less structured group work is the positive interdependence. Positive interdependence means that the learners are individually accountable for their own learning as well as the learning of the entire group. Cooperative learning requires the student to be interactive with other students to a much larger degree than normally expected during a typical college lecture or discussion (Totten, Sills, Digby, & Russ, 1991, p. 1).

The pairing of students to enhance higher order learning and critical thinking has been reported recently in nursing and medicine (DiCarlo & Rao, 2000; Van Horn, 2000). When students are paired, they work on a common intellectual product and subsequently receive a grade that is dependent upon the success of their interactions. When students work together in pairs they must communicate their common understandings but they also encounter differences that must be explored and resolved. The students’ interest and learning has an opportunity to peak when differences between the students arise. When a difference surfaces, students realize that there may be an opportunity for gain and a risk of losing. A difference can mean that one student has a better understanding than the second student or that there are two feasible options. If one option is better than another, the group is at risk because students could choose the wrong option but they also have an opportunity for success. It is the realization of the shared opportunities to lose and
succeed that motivates students to listen and problem-solve together, and this shared future develops a positive rather than a competitive relationship that is motivating. Pairing students necessitates the active involvement of each student, results in higher performance on quizzes, and demonstrates an improvement in higher order thinking (DiCarlo & Rao, 2000). For pairing to be classified as cooperative learning, however, it must include positive interdependence. Positive interdependence means that the outcome of each student is dependent upon the other students’ work. Placing students in pairs does not mean that learning will be maximized; in fact, it can be harmed. What largely determines whether this will be positive or negative is “how the faculty members structure the interdependence in the learning situation” (Johnson et al., 1991, p. 2:4). And the key structures that make the difference are effective positive interdependence and effective peer feedback. The effective use of “Peer Feedback” is when group members candidly provide information on how well they are “fulfilling their responsibilities and completing their work” (p. 2:7). So whereas in cooperative learning the emphasis is on active learning on the part of the student, the role of the teacher is more complex and is central to learning success, because the teacher has to know how to effectively organize group activities with positive interdependence and peer feedback.

Students may be placed into informal cooperative pairs in a variety of settings. They may be asked to journal with a partner as a reflective activity following clinical practice (Van Horn, 2000). A 50-minute class period may be divided into three or four short presentations interspersed with questions to be discussed in pairs, with the goal of improving retention and higher order thinking (DiCarlo & Rao, 2000; Lozano, 2001) such as analysis, problem solving, and synthesis as opposed to recall. Additionally, a
testing process may be used in which students are first tested traditionally as individuals and subsequently paired and retested (Johnson et al., 1991, p. 4:27). The purpose of testing and retesting is that it gives students who have committed to different answers the practice and incentive to communicate their own assumptions and to evaluate the assumptions of their classmates. Then they must negotiate a shared answer that communicates the collective outcome of the process—an answer to which they both contributed and both can agree. These are the kinds of communication, critical thinking, and negotiation skills they will need in the hospital. Alternatively, students may be assigned to provide peer teaching (Ellis & Foutes, 1993, p. 109). Cooperative learning methodologies involving pairs add to the menu of learning strategies to be considered in the development of critical thinking.

Another example of a cooperative learning strategy known to improve critical thinking is the academic controversy (Johnson et al., 1991, p. 7:5). Academic controversy may be planned through the assignment of opposing positions to be presented in a classroom. There are several classroom settings in which natural academic controversy may be augmented and used to improve learning. Academic controversy may be contrasted with debate, concurrence seeking, and individualistic learning. In a debate the students appoint a judge who then determines who won the case. In contrast, academic controversy requires students to share the reasons for their positions and to carefully consider possible contradictory reasons given by their partner. The contrast is that in academic controversy a student would be encouraged to change positions whereas in a debate the focus is more on winning and less on emphasis on the pursuit of truth.
Researchers Johnson and Johnson (1988) established the ability of structured controversy to result in an “increase in students’ perspective taking abilities, greater student mastery and retention of the subject and greater ability to generalize the principles learned to a wider variety of situations; higher quality decisions and solutions to problems” (p. 63). Concurrence seeking refers to those tendencies and actions observed when students try to come to agreement prematurely without carefully articulating the reasons for their previously held positions. Individualistic thinking or learning and classroom structures are emphasized in traditional learning contexts that are said to be competitive and antisocial because when one classmate does well on a test graded using the statistical assumptions of a normal distribution it can adversely affect the evaluation of the classmate (Johnson et al., 1991, p. 2:5). In such situations when one student wins, another loses. In contrast to these educational methods, the careful sharing of reasons and information and the consideration of the reasons provided by partners that is characteristic of cooperative learning leads to the kind of critical thinking needed in respiratory care. Respiratory therapists should not demonstrate their listening skills by changing their position unless the alternate position is superior. This careful listening attitude will also encourage others in the clinical setting to consider other points of view carefully and critically. The reciprocal sharing of ideas and information is necessary to gain the full advantage of each clinician’s unique expertise.

Johnson et al. (1991) compare the advantages of academic controversy over the learning outcomes seen in debate, concurrence seeking, and individualistic learning (pp. 7.3-7.5.1). Students participating in academic controversy were found to reach a higher level of both mastery and retention. They made better decisions when encountering
complex problems with several plausible answers. Students engaged in academic controversy were more creative and exchanged a higher level of expertise. Their emotional commitment also exceeded those participating in other modes of learning. Johnson et al.’s research has shown that academic controversy demonstrates elevated levels of learning according to several measures. Academic controversy, as well as other collaborative approaches, is likely to develop the particular skills in critical thinking that are necessary to the respiratory therapist. The ability to carefully consider alternate assumptions in an interactive environment with other clinicians is a key skill in the clinical respiratory context.

**Problem-Based Learning**

Problem-based learning (PBL) is a self-directed strategy advocated by physicians, nurses, and respiratory therapists, among others, for the development of critical thinking and clinical decision making (Mishoe, 1993, p. 33), in contrast to the traditional lecture format. PBL includes group work and loosely structured, or more lifelike, problems. Placing students in an interactive environment with their peers naturally requires them to consider alternate viewpoints and underlying assumptions. Students carry major responsibility for their own learning (Ceconi, Op't Holt, Zipp, Olson, & Beckett, 2008, p. 58). Furthermore, an ambitious group assignment will involve the kind of critical-thinking required of a graduate. Perhaps this is why PBL has such a wide range of professional advocates.

Respiratory care educators have identified various elements and components as fundamental to PBL. “The essential components of problem-based learning include an integrated curriculum rather than one separated into clinical and theoretical components,
curriculum organized around problems versus disciplines, and an emphasis on cognitive
skills as well as knowledge” (Mishoe, 1993, p. 33). Three essential elements have been
identified: the learners, the problem, and the tutor (Op’t Holt, 1994, p. 21). PBL can be
seen as radically divergent from traditional instruction.

PBL provides the student with opportunities to actively and autonomously
investigate and solve relevant problems in groups. While the resolution of a problem is
important, it is not the primary goal. The main goal is to gain practice in using essential
skills of critical thinking such as communication and negotiation. Success is dependent
on the careful identification of the assumptions or evidence underlying the beliefs
adopted by group members as well as the use of logic and reflection.

Participation by every member of the group is essential for a successful activity
(Op’t Holt, 1994, p. 23). Students must share their thoughts, knowledge, and feelings with
the group, showing a willingness to admit what they do not know and allowing the group
to profit from the combined exchange of ideas.

A key way in which PBL differs from more traditional lecture-based instruction is
that the problem is presented first, rather than following a presentation or lecture over
relevant content. “Problems are presented as real patients or written case histories” (Op't
Holt, 1994, p. 29). Students have the freedom to determine or prioritize learning issues,
access a wide variety of information, and ask relevant questions regarding patient
examinations, laboratory tests, and patient response to applied therapeutic procedures as
they work through a given course.

Op’t Holt (1994, pp. 34-38) provided a careful and detailed review of research
findings related to PBL. In this review, he reported findings typical of the complexity of
PBL outcomes. Interestingly, problem-based learning may not necessarily teach problem-solving skills. The report suggested that problem-solving ability might be more of an intrinsic characteristic than a learned trait. However, the review also found that PBL may initially reduce levels of learning but may foster increased retention of knowledge over periods up to several years. Problem-based learning may enhance both transfer of concepts to new problems and integration of basic science concepts into clinical problems, and it appears to enhance self-directed learning skills, and this enhancement may be maintained (p. 37). Op’t Holt (1994) concluded his review of relevant PBL research by advocating a respiratory therapy curriculum that seeks to capture the benefits of both PBL and the conventional curriculum (p. 38).

Recently Beachey (2007; Mishoe, 2007) examined several measures of program outcomes for two PBL and two traditional baccalaureate degree respiratory therapy programs. The program outcomes included employer and graduate satisfaction and National Board for Respiratory Care (NBRC) Certified Respiratory Therapist (CRT) and the Written Registered Respiratory Therapist (RRT) examination scores. The most important findings from this study showed that PBL graduates were not at a “disadvantage on standardized, objective tests of knowledge, such as licensing and credentialing examinations” and that PBL graduates were more satisfied “with the quality of their education” (Beachey, 2007, p. 1504).

More recently Op’t Holt, Ceconi and others (Ceconi et al., 2008) published results of their retrospective, correlational research comparing program data prior to and after implementing PBL in one respiratory care program that compared data from 1996-1999 with data from 2000-2003. “The NBRC Clinical Simulation Examination DM scores and
the PBL curriculum had a high positive correlation of ($r=0.583$, $p<0.01$). This finding demonstrated that students from the PBL curriculum scored higher on the NBRC Clinical Simulation Examination than students in the traditional curriculum” (p. 61). This resulted in a 27-point advantage on the NBRC Clinical Simulation examination for graduates of the PBL program. Problem-based learning as implemented in the program studied was shown to improve decision-making skills. The implications are that PBL improves critical thinking because decision-making skills have been correlated in respiratory care credentialing examinations with measures of critical thinking (Mishoe, Dennison, & Thomas-Goodfellow, 1997).

PBL is an example of a method of organizing education that is learner centered and requires collaboration between students. Conclusions about the effectiveness of PBL have been considered tentative (Finucane, Johnson, & Prideaux, 1998). The implementation of PBL in one respiratory care program resulted in a 27-point advantage on the NBRC Clinical Simulation Examination DM scores over those students in the traditional curriculum. It is an important strategy because of the potential for improvement in measures of critical thinking, student satisfaction, and the enhanced development of autonomy in learning needed for clinicians to stay current after graduation. PBL has strong advocacy among respiratory care educational leaders.

Mishoe (1993) describes the heavy use of lectures in teaching as an inappropriate means of developing critical-thinking skills (p. 33). Instead, she recommends case-based instruction, PBL, and small-group discussion. Op’t Holt (1994) describes PBL as “an opportunity for health care education to rely less on lectures, memorization of facts, and the use of lower-order cognitive skills” (p. 18). PBL is recommended as a method of
radically reconstructing education to meet the need for developing the critical-thinking, problem-solving respiratory care practitioner. Op’t Holt (1994) characterizes problem-based learning as “an instructional method that provides students with the skills to solve problems and acquire information and stresses self-directed learning, independent and critical-thinking skills, and clinical reasoning” (p. 18). Op’t Holt (2000) provides a description of a first-year experience with problem-based learning. The greatest difficulty reported was the students in one group refused to believe that students in a different group were identifying the same learning issues and resource needs (p. 52). He noted that most students enjoyed the process and performed better than their predecessors on the National Board for Respiratory Care Entry Level Examination. Ceconi et al. (2008) have reported higher DM scores on the NBRC Clinical Simulation Examination for graduates of a problem-based learning program.

Mishoe (1997) calls for educational reform in respiratory care, advocating the implementation of problem-based learning. A primary justification for this recommendation is that problem-based learning requires the student to “work collaboratively with others; to manage time and resources; and to develop the skills and characteristics of a critical thinker” (p. 82).

Cognitive and decision-making ability can be improved by enhancing skills in evaluation and in using evidence (Mishoe & Welch, 2002). Critical thinking in practice is described as inductive reasoning about a large number of loosely structured problems that have no single solution. Decisions must be made in a context of uncertainty. The criteria on which to base decisions are often in dispute, and empirical evidence on effectiveness
of different treatments is often lacking (p. 513). Problem-based learning provides a venue for learning how to approach these challenges.

As a means of improving respiratory therapy training and subsequent patient care, Mishoe (2002) recommends that students receive greater “opportunities to engage in critical discourse in order to improve communication, negotiation, decision-making, and reflection” (p. 514). The elements of critical discourse include listening, sharing, and evaluating that are common to other interactive critical-thinking strategies. These are the activities that develop during problem-based learning.

In a 2002 editorial, after commending the Socratic method and problem-based learning, Mishoe (2002) writes that “we need further study of the effectiveness of educational strategies to promote the development of critical thinking and decision-making” (p. 568). Mishoe encourages more research in discipline-specific strategies to develop critical thinking because if the collective critical-thinking skills do not advance, the profession could stagnate in technical task-oriented service. Alternately, this profession may expand as patient and technical assessors, which would result in better patient care.

In summary, problem-based learning offers a strategy where students can learn the real-world skills of identifying issues, researching them, presenting knowledge, interacting and challenging each other and therein learning to think critically. Problem-based learning has demonstrated higher DM scores on Clinical Simulation Examinations.

**Critical Thinking in Respiratory Care**

In an effort to search the literature for journal articles on the subjects of critical thinking, decision making, reflection, and cooperative and collaborative education in
respiratory care, searches of the following databases were undertaken: Education Resource Information Center (ERIC), PubMed Central (PMC), Medical Literature Analysis and Retrieval System Online (MEDLINE), Proquest Digital Dissertation Abstracts, Wilson Select, and the American Association for Respiratory Care (AARC) website.

The online literature searches demonstrate a significant need for additional studies regarding the development of critical thinking through respiratory care education. Respiratory Care educators and authors Shelledy, Gardner, and Wettstein (2004) make this point by writing that, unfortunately, “it is not clear how to best teach critical thinking, and methods to assess critical-thinking specific to respiratory care are not readily available” (p. 16).

Nursing scholars have made a major contribution to the critical-thinking literature in healthcare. This is likely due in part to the critical-thinking accreditation outcome requirement of the National League of Nursing (Videbeck, 1997). The respiratory care literature contains faculty evaluative summaries and accounts of the implementation of critical-thinking-enhancing pedagogies (Beachey, 2007; Hagan, 1996; Op't Holt, 2000).

The published respiratory care articles may be divided into three general topics:


2. Correlation of measures of critical thinking with respiratory care credentialing examinations (Hill, 2002; Hixon, 1985; Mishoe et al., 1997; Shelledy, Gardner, Carpenter, & Murphy, 2004; Shelledy, Gardner, & Wettstein, 2004b)
3. Recommendations for strategies or approaches to assist in the development of critical thinking (primarily problem-based learning) (Mishoe, 1993, 2002; Mishoe et al., 1997; Mishoe & Welch, 2002; Op’t Holt, 1994, 2000; Shelledy, Valley, & Murphy, 1997).

Measurement of Critical Thinking in Respiratory Care

Goodfellow (1999) found experience to be key to the understanding of critical-thinking behavior in respiratory therapists. Facione, Mishoe, Dennison, and Goodfellow (1997, as cited in Goodfellow et al., 1999) support a statement that the Clinical Simulation Exam (CSE) from the National Board for Respiratory Care (NBRC) is one of the few domain-specific instruments for the assessment of critical thinking. Goodfellow et al. also reported on the validity and reliability of an empirically constructed, respiratory-care-specific critical-thinking instrument. More recently, Shelledy et al. (2004) reported the development and study of an instrument for the assessment of respiratory care students’ critical-thinking and problem-solving ability. This instrument was found to correlate well with Watson-Glaser Critical Thinking Appraisal ($r=0.54; p=0.02$) and NBRC CSE information gathering ($r=0.51; p=0.03$) and decision making ($r=0.74; p=0.0003$).

Goodfellow (2001, 2002) identified three types of respiratory therapists: (a) individuals labeled type 1, with highly situated problem-solving skills and high communication skills; (b) individuals labeled type 2, with low situated problem-solving skills and low communication skills; and (c) individuals labeled type 3, with highly situated problem-solving skills and low communication skills (Goodfellow, 2002).
In the earlier article, Goodfellow (2001) reported the self-ratings of various aspects of critical thinking by 975 respiratory therapists. These therapists rated themselves highest in prioritizing, troubleshooting, and communication, and lowest in anticipation. Goodfellow (1999) recommended the inclusion of situated cognition where one learns in the clinic or place of application; reflection-in-action entails “building new understandings to inform our actions in the situation that is unfolding” (Goodfellow, 1999; Smith, 2001, p. 10) and problem-posing in professional curricula in which the instructor and the student “teach each other” based upon the problems that naturally present themselves through the clinical environment (Freire, 2005, p. 80). Mishoe (1995, 2003) reports that critical-thinking in respiratory care practice involves the abilities to prioritize, anticipate, troubleshoot, communicate, negotiate, reflect, and make decisions.

Mishoe and MacIntyre (1997) published a paper as an outcome of the 1996 American Association for Respiratory Care International Conference on emerging health-care delivery models and respiratory care, held in Cancun, Mexico. In this report, the work of the respiratory care profession is described as “complex, esoteric and discretionary” because “it requires theoretical knowledge, skill, and judgment that . . . people do not possess, may not wholly comprehend and cannot readily evaluate” (p. 72). Respiratory care is said to be “at a crossroads in its growth into a profession” (p. 73) because it could either become task oriented or it could grow into care management. Task-oriented care would mean that respiratory therapists operate as less intellectually skilled performers of procedures ordered by others, whereas care management includes intellectual skills in patient assessment and skills in directing care in harmony with protocols and clinical practice guidelines. Respiratory care has been rapidly expanding
into the use of therapist-driven protocols using clinical practice guidelines developed out of evidence-based medicine. Where at one time respiratory therapists were expected to follow orders given by physicians, for over 10 years medical directors have utilized therapist-driven protocols (Wood, MacLaod, & Moffatt, 1995), which are broad assess and treat protocols that require respiratory therapists to assess patients and determine appropriate treatment from a host of complex options. These protocols are based upon meta-analysis of clinical research known as evidence-based medicine and the support of prestigious physician organizations (Force, 2002). Now, physicians (Rubenfeld, 2004) label respiratory therapists as central to the translation of clinical research into clinical practice. The issues and opportunities of expanded scope of practice (Orens, Kester, Konrad, & Stoller, 2005) make a case for the inclusion of critical thinking as a core component of respiratory care curricula. According to Mishoe and MacIntyre (1997), critical thinking is not sophist thinking that can be relegated to academic exercises. A shallow definition of critical thinking would exclude elements of problem solving, speaking, writing and reading but the critical thinking required of respiratory therapists includes all of these (p. 79).

Respiratory care scholars are concerned about encouraging critical thinking where it will make a difference. For the respiratory therapist, critical thinking makes a difference when it is shared through written, verbal, and tacit body-language methods of communication. In speaking about communication, Mishoe and MacIntyre (1997) write, “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). Critical thinking in respiratory care is “not possible unless the
A practitioner can communicate effectively with others as a primary means for giving and receiving information needed for patient care” (p. 79). Other definitions of critical thinking may not emphasize communication, but for the respiratory care profession thinking without communication is of no practical value.

What we see in published respiratory care literature is a consensus regarding the abilities that respiratory care practitioners actually exercise when practicing critical-thinking. Specifically, they are interactive and communicate with the people around them. Their critical-thinking includes both problem-solving and decision-making skills, but it is essential that the patient and the other caregivers are involved in the process. Respiratory therapists have a foundation of knowledge, and they use strong patient assessment skills and evidence-based protocols to make decisions regarding the allocation of their technical skills (p. 77). But “the development of cognitive skills and metacognitive strategies for decision-making are insufficient for decision-making in actual clinical practice. The allocation of cognitive skills must be communicated and negotiated, and are essential for decision-making and critical-thinking in practice” (p. 79).

Correlations With Credentialing Examinations

Based on a study of 312 research subjects, Hixon (1985) demonstrated a positive correlation between experience and clinical simulation performance. While the clinical simulation examination has been identified as a domain-specific measure of critical thinking (Goodfellow et al., 1999; Mishoe, 1997, p. 78), Hill (2002) reported a statistically significant correlation between critical thinking, using students’ scores on the Watson-Glaser Critical-thinking Appraisal-measured CT and the measured decision-
making score on the Clinical Simulation Self-Assessment Examination (CCSAE, developed by the National Board for Respiratory Care) for 110 students of $r = 0.32, p < 0.01$. Shelledy et al. (2004) reported a study of 36 first-year students from two area schools. The Shelledy study demonstrated correlation between Watson-Glaser Critical Thinking Appraisal scores and performance on the National Board for Respiratory Care (NBRC) Certified Respiratory Therapy Self Assessment Examination ($r=0.51; p=0.001$) and Clinical Simulation Problem Information Gathering scores (IG) ($r=0.54; p=0.001$). The study supports the supposition that critical-thinking ability may be useful in predicting student performance in a respiratory care program. The Beachey (2007) study did not show a difference between NBRC Certified Respiratory Therapist (CRT) and Written Registered Respiratory Therapist (RRT) examination scores between two programs using problem-based learning and two traditional programs. The Ceconi et al. (2008) retrospective study demonstrated a 27-point advantage in DM scores on the NBRC Clinical Simulation examination for students completing a problem-based learning program compared to students completing a traditional program. While these correlations are noteworthy, respiratory care educators must have concerns that encapsulate more than credentialing examination success. Educators must also concern themselves with speech and writing. That is, in respiratory care, improvement in critical thinking may include two quite divergent applications: An improvement in the interactive functionality in clinical settings, as well as student and graduate performance on credentialing exams measuring critical thinking.
Other Perspectives Regarding Educational Strategies

In a letter published in *Respiratory Care*, Hopper (2002) expresses doubt about several issues involving education and critical thinking. He doubts that decision-making scores on the National Board for Respiratory Care Clinical Simulation Examination actually measured decision-making in the pure sense. Instead, he asserts that students are taught to memorize a “few problem-solving rules,” and that they are taught “mastery of the gamesmanship element of branching-logic simulations” (p. 1019). He also doubts that critical thinking can be “instilled” in students (p. 1019). To Hopper there is “no evidence that CT can be taught to low-caliber students” (p. 1020). Hopper (2002) went on to say that “the dominant instructional method in respiratory care is lecture.” In a letter published in the same journal, Glenn Roberts (2002) also expressed his disbelief: “From my observations CT (critical thinking) and DM (decision making) are skills. They must be practiced, tested, and refined in order to grow” (p. 1018). Because Roberts does not believe that critical thinking can be taught or that the health-care environment fosters the growth of critical thinking he encouraged the use of measures of critical thinking in program-selection criteria.

**Social Learning Theory Applied to Teaching Critical Thinking**

Even those who advocate the use of active learning strategies represent their use as a challenge. For example, the ability to effectively organize cooperative learning has been recognized by researchers as more complex for the teacher and as requiring considerable training (Johnson et al., 1991, p. 1:7). This suggests that inexperienced or insufficiently trained faculty could ineffectively administer or initiate active-learning strategies. By contrast, are there principles that expert faculty believe and adapt to
strategies that enable them greater success? Social learning theory (Bandura, 1977; Vygotsky, 1978) offers a framework that aligns with this study regarding the principles that expert respiratory therapy faculty believe and successfully apply to the application of active-learning strategies. The expert application of these principles results in the learning of critical-thinking skills.

Social learning theory contends that learning occurs in contexts in which individuals are attentive to models (Bandura, 1977, p. 24) that demonstrate behaviors to be learned and observe or experience reinforcement (pp. 97-158). Additionally, learning occurs in the zone of proximal development (Vygotsky, 1978, pp. 86, 87) where the student can perform skills with stronger peers that she is unable to perform alone. Many educational strategies present situations in which there are these social learning models from which the student can learn.

A number of factors determine whether people will act on what they have learned (Bandura, 1977, p. 51). Students and faculty, their behaviors, and the environment are interdependent causes of behavior or learning (p. 9). Bandura states: “Outcomes change behavior in humans largely through the intervening influence of thought” (p. 18). People who are attentive to their own behavior and the behavior of others (models) within a bewildering variety of circumstances develop expectations of which behaviors will produce desirable outcomes under certain circumstances (p. 90). Modeling, attentiveness, thought, and reinforcement are factors that influence learning. In addition, students are more likely to demonstrate learning if they develop self-efficacy in the area of study. This self-efficacy is extended when students perceive their power to successfully interact in the environment to determine outcomes. “Superior accomplishments, whatever the field,
require considerable self-disciplined application” (p. 207). Once students notice the effect of their efforts, their level of self-efficacy increases and they develop elevated levels of self-reinforcing drive.

Even in the absence of external recognition some people become convinced of the value of their own “work and labor tirelessly even though their productions are negatively received” (p. 207). It is this belief in one’s self and ability to bring about positive change in the environment that provides the necessary motivation for student success. This self-efficacy can be developed by giving the student challenging assignments over which they have control. Once they have gained success self-efficacy grows and they begin to self-prescribe standards for their own work (Bandura, 1977, p. 130). Because the beliefs and practices of the expert faculty in my case study echo those articulated in social learning, in subsequent chapters I take social learning theory and connect it to my research data and propose a metaphor and a mathematical representation.

**Summary**

Civilized humans have been concerned about the quality of thinking for thousands of years. Many aspects of critical thinking have been described by various professional bodies and scholars. Critical thinking in respiratory care is broader than a mere reflective judgment regarding what one should think or do. It includes the ability to communicate and interact with people of various perspectives in order to arrive jointly at a superior decision.

General characteristics of teaching strategies that have been recommended for the development of critical thinking have been identified. These are an increased use of varied classroom strategies and collaborative teaching methods, including the use of life-
like complex problems. These strategies concern themselves with developing thinking processes while encouraging active learning.

Cooperative learning and PBL are two examples of critical-thinking strategies. Academic controversy is a form of cooperative learning that involves the students in an interactive, open-minded listening and speaking process. Pairing is also a cooperative learning technique and involves putting two students together to construct knowledge and solve problems. PBL is different from traditional, highly structured laboratory and lecture instruction. In PBL, the student’s exploration of a clinical problem dictates the direction of inquiry. While the goal of PBL includes developing critical-thinking skills, respiratory care educators recommend a curriculum which also benefits from conventional approaches such as case-based instruction, writing, and presenting. Respiratory therapists who are writing about education in peer-reviewed journals understand and appreciate “a repertoire of models that are very good for particular purposes” (Joyce, Weil, & Calhoun, 2004, p. xiii). No respiratory care scholar is advocating the use of one strategy to the exclusion of all others.

A review of respiratory care literature provides articles in several areas: studies of the measurement, assessment, identification, and descriptions of critical thinking; the correlation of critical thinking with respiratory care credentialing examinations; recommended strategies for the development of critical thinking; and skepticism regarding the ability of educational strategies to impact critical thinking. No case study exists describing the expert practice of respiratory care critical-thinking strategies as understood by a program’s faculty or the expert faculty’s perceptions of these strategies. Beachey recommended a realistic qualitative study that would help to identify how
context influences learning. Social learning theory offers a framework for understanding the factors that expert faculty believe are important in teaching critical thinking.

This case study provides a picture of the beliefs, strategies, and program components that expert faculty believe are important in developing critical thinking. It will demonstrate what faculty, known to be effective in delivering problem-based learning and producing graduates adept at critical thinking, actually believe. It will show how these faculty implement educational strategies and what program components they use to do this effectively. This study will demonstrate aspects of social learning theory and propose a metaphor and mathematical model to stimulate discourse and abstraction about education.
CHAPTER 3

METHODOLOGY

Introduction

The purpose of this study was to investigate the critical-thinking teaching strategies employed by respiratory care faculty and their current beliefs regarding those strategies. This investigation explores several questions and serves as a resource to the respiratory care authors, educators, and policy makers. This study was designed to address the following questions regarding current critical-thinking learning strategies used by respiratory care faculty in the United States: What are the faculty beliefs concerning the development of critical thinking? How are learning strategies consistently implemented by expert respiratory care educators to enhance critical thinking and problem solving in their students? What program components support the development of critical thinking?

Qualitative Methods Design

To answer the above questions, a single qualitative case study of a strong program nominated by expert members of the Committee on Accreditation for Respiratory Care was conducted. The use of educational strategies used in respiratory care programs in a tri-state area (Ohio, Indiana, and Kentucky) has been noted (Hill, 1999) in other research.
This study seeks to produce new data about the ideas that faculty members of an academically strong program have about what is needed to develop critical thinking.

In qualitative research, the primary epistemology is based upon the assumption that “reality is constructed by individuals interacting with their social worlds” (Merriam, 1998, p. 6). This research emphasizes the thoughts of the participants regarding what pedagogical approaches are effective in the development of critical thinking.

I chose to use the qualitative case study format because this method not only provides answers to the above stated research questions, but serves as a basis for considering educational theory and further research. Numerous authorities in respiratory care have made recommendations in favor of various critical-thinking learning strategies, but to the uninitiated these strategies may seem like mere abstractions. Eisner (1994) suggests that constructing these active educational tasks is “not easy” (p. 204). In a qualitative description, faculty may be able to more readily imagine or vicariously experience what it is like to be a faculty member or a student while these methods are employed (Eisner, 1994, p. 213). Descriptions and observations provide concrete examples of how expert faculty focus their efforts in the application of critical-thinking strategies, allowing others to envision themselves in similar situations.

**Purposeful Sample**

One program was selected using purposeful sampling based on the nominations of critical-thinking experts representing CoARC, the national accrediting body. The likelihood of finding important strategies for dissemination increases because this program has a reputation for excellent educational practice among critical-thinking experts at CoARC. Once three nominations were secured, both the amount of scholarly
writing coming from the program and the number of experts who nominated the program were considered. One program was contacted to negotiate and secure participation in the proposed research.

**Researcher as Primary Instrument**

The qualitative researcher is considered the primary instrument for data gathering and analysis (Cresswell, 1994, p. 145; Eisner, 1998; Merriam, 1998). When a study involves an exploration of the metacognitive, it must involve the only instrument that can detect, understand, and communicate in this realm—the researcher. The rationale and the cognitive models used and given by educators and students to determine the potential effectiveness of certain strategies are not measurable by any physical or observational methodologies. These constructs can be detected only through human verbal and nonverbal means of communication. Although human actions hint at actual cognitive constructs, it is through communication that the qualitative researcher enters the thought processes of those studied. Once invited into the participant’s mental world, the qualitative researcher may request that a certain model or construct be examined. The researcher may then compare the model with other systems of education or experiences that she already understands. Through this common associative process, the researcher comes to an understanding of the usefulness of the relationships observed and a better understanding of what is observed. At this point the researcher has an idea of what she might try in the classroom herself or what she might recommend to others.

In this case study, I first observed learning in the classroom and then recorded interviews that were transcribed. Each participant’s thoughts were recorded and coded using a cross-comparative method. Qualitative research is characterized by the
researcher’s observations and interaction in fieldwork. Interaction can enhance internal validity, so I submitted my understanding back to the participants in a member-check process. According to Merriam (1998, p. 204): “A number of writers suggest doing this continuously throughout the study.” This qualitative study sought to uncover the meaning attributed to educational activities and processes. During the interview I would periodically summarize the participant’s understanding for her validation. The member checks continued after transcription and in the theme-identifying phase as well.

My interpretations come from the perspective of 24 years as a full-time faculty member in respiratory care education. I have served both as Director of Clinical Education and Program Director for an Associate of Applied Science (AAS) program in respiratory care. A milestone in my career came in July 2004, when I orchestrated the transfer of our respiratory care program from Rogue Community College to the Oregon Institute of Technology, a member of the Oregon University System. I am now the Program Director of both an AAS and a Bachelor of Science (BS) program through the Oregon Institute of Technology.

Upon entering the leadership Ph.D. program at Andrews University in 1999, my interest in the art and science of education has intensified. My appreciation of and experience with active forms of learning, collaborative learning, systems of grading, and the use of technology to provide distance education have changed dramatically. It is these experiences that provided the filter through which I interpret what I saw and heard.

Data Collection

Data were collected as field notes recorded during classroom observation, audio-taped interviews with administrators and faculty, artifacts as PowerPoint slides and
course syllabi and review of program outcomes, and student formative and summative outcomes as understood by program faculty (Merriam, 1998) and as studied by others (Beachey, 2004). During the research process my biases, thoughts, and analyses were recorded often in e-mails sent to participants, to the dissertation chair, or to myself. This study describes what approaches faculty consider effective in the development of critical-thinking, as well as their reasons for these beliefs. An emphasis was given to recording how activities and approaches are used, implemented, and interpreted, that is, the teaching and learning experience. The interview data collected provide insight into the educational culture, and shed light on expert education (Ari, Goodfellow, & Rau, 2003).

Classroom Observation

Classroom and clinical observations were recorded as field notes. The field notes recorded the individual setting, for example, the laboratory. I constructed a form that prompted me to look for particular categories of data as recorded below in this section. An example of the use of columns to provide observational and associated interpretive or metacognitive understanding can be found on pp. 86-87 of Narrative Inquiry (Clandinin & Connelly, 2000).

I recorded information relative to what was unique about an observed class, such as its size, gender, and ethnic diversity; the professional background of the professor; and the lighting, heating, noise level, presence of distractions, amount of resources, chairs, desks, tables, access to the internet, software, and books. I paid special attention to recording indications of student and faculty affect. For instance, the students appeared interested and engaged in the subject. The students were on task as opposed to wasting
time. The students and faculty frequently used humor and smiled at each other. The students and faculty did not appear to be under stress.

Regarding the actual instruction, my notations included a record of time, the directions given by the instructor, and any sort of organizational system that the students followed. I could not access the handouts or resources provided to students, which they are expected to download from the university website and bring to class. The field notes recorded what the students and faculty were observed to be doing. This included a description of student and faculty body language as well as spoken communication. I also recorded my thoughts and interpretations of what I observed, using a form that allowed me to record various kinds of data in specific regions of the form. One section provided the record of activities; another, verbal instruction and student responses.

Audiotaped Interviews

After these observations were complete, I conducted faculty interviews using audio recording equipment and asked questions designed to determine faculty thoughts regarding the intent of classroom activities. Interviews were conducted with senior faculty as well as with those who had only recently joined the faculty ranks. I sought to ascertain how effective they perceived the learning environment to be, and how typical the interaction I observed was of their program and practices. Additionally, I disclosed my observations and thoughts for the participants to address, giving them the opportunity to clarify their thoughts. Interview forms facilitated the collection and written notations from the interviews and served as a reminder of questions covered.

Additional interviews were conducted with the program directors and university administrators to gain a sense of how the methods used in the respiratory care program
are understood and what administrative means of support may or may not be supplied specifically in light of these pedagogical approaches.

Audiotaped faculty and directors’ interviews inquired into two areas: (a) how they came to use critical-thinking pedagogies, and (b) their understanding of the program outcomes, such as examination pass rates or employer and graduate satisfaction survey results.

Artifacts

Photographs were taken of program classrooms, equipment, and laboratories. Sketches were made of the extensive offices, the respiratory therapy library, the meeting rooms, and the layout of other resources in the building. The faculty provided 28 course syllabi and 111 pages of PowerPoint slides. Of the syllabi it was clear that 21/28 or 75% gave points for active-learning assignments. Consistent with the faculty interviews, the syllabi designated the use of problem-based learning, verbal presentations with media, peer evaluations, data collection or research, development of a case study, class participation, asking questions, and pro and con debate.

The pictures and sketches document the level of resources available to this program in light of Ari’s (2007) study suggesting that resources should be considered when interpreting program outcomes. Additionally, institutional program information was collected from the internet.

Journaling and Field Notes

Following the interviews, I wrote journal entries detailing my impressions, thoughts, and analyses (Merriam, 1998, p. 238). I recorded the date and time of each entry as well as what was happening in my research processes.
Data Analysis

The analysis and member-check process was contemporaneous with data collection (Merriam, 1998, p. 151) and also followed the initial data collection. During interviews I frequently restated my understanding of what was said so that those being interviewed could immediately confirm or modify my interpretation. I recorded my thoughts in conjunction with the field notes collected. My thoughts were shared with participants in order to inquire into their appreciation and understanding of the observed events.

The critical-thinking strategies used were identified in the record of classroom observations. My perceptions of important aspects of classroom activities were shared in an interactive process with the corresponding participants (Merriam, 1998, p. 151). This allowed the faculty member to provide his or her analysis of how they understand what they are doing in the classroom.

Program artifacts in the form of sketches were analyzed in a similar interactive process. The data sketched were discussed with the respiratory care expert faculty during the interviews.

Although I began transcribing interviews in the evenings while on location, the process continued for several months following data collection. Transcribed interviews were returned to participants for correction. Subsequently, after coding, I sought to organize the data for better understanding. I compared the coded data with the education literature. I thought I saw similarities between the physiologic transfer of gasses in the body and the transfer of critical-thinking knowledge in a program. I sent my ideas back to the senior faculty and received their endorsement. The information was presented in an
iterative clarifying process to my dissertation chair. This resulted in a metaphor and a corresponding mathematical model. Subsequently, the findings and model were analyzed as to how they relate to the social learning theoretical framework.

**Validity and Reliability**

The opinions of the expert faculty are explored, recorded, and shared through the medium of this study. It is of utmost importance that the record of these opinions is accurate. To assure accuracy, the record of faculty opinions was reviewed by the participating faculty before being finalized for the report. This process is meant to be consistent with what Merriam (1998) referred to as *member checks*—“taking data and tentative interpretations back to the people from whom they were derived and asking them if the results are plausible” (p. 204). The member-check process was a participatory and collaborative mode of research.

The data collected came in the form of in-class observations, as well as faculty interviews, as the basis for their understanding of strategy success (Eisner, 1998, p. 110).

Member checks increase internal validity by ensuring that the researcher does not mistakenly misrepresent the ideas and opinions of the expert faculty under study (Eisner, 1998, p. 112).

I collaborated with the program faculty by way of member checks in order to facilitate accurate understanding of the findings. The expert faculty studied have an established interest in research and are skilled at analyzing data. The interest and collaboration by participating faculty provide an additional source of validation.

The researcher’s biases, worldview, and theoretical orientation were described to key participating faculty at the outset of the study during the Institutional Review Board
(IRB) approval process. This declaration provided insight to participants of the study regarding the influence such biases were likely to have on study outcome.

**Generalization**

The knowledge gained from a case study involving the analysis of nine interview transcriptions is different from a randomized controlled trial with a treatment group and a control. Because educational “conditions and contexts vary” (Eisner, 1998, p. 208) so much of the information presented in an educational case study is not a “prescription to follow” but rather the presentation of “ideas to be considered” (Eisner, 1998, p. 209). Qualitative case studies are said to be “full of opportunities for generalization” (p. 207) but these should “be shared and discussed, reflected upon, and debated” (p. 205), because it is the readers who must determine if findings can be applied to a particular workplace.

**Institutional Review Board (IRB)**

To meet IRB requirements for the participating institution, I submitted the required research protocol and informed consent form. These protocol and consent forms were repeatedly revised in compliance with IRB recommendations. The protocol was classified as an educational case study and approved as exempt from full review. I submitted current CVs for both the dissertation chair and myself and obtained a faculty sponsor from the participating institution. No conflict of interest was identified. In addition, I completed the required Collaborative Institutional Training Initiative (CITI) web-based education and provided evidence of mandatory Health Insurance Portability and Accountability Act (HIPAA) training.

Following approval by the participating institution’s IRB, I applied for approval from the Andrews University IRB. Changes to the informed consent required by the
Andrews University IRB were subsequently approved by the participating institution’s IRB as well. The process of obtaining IRB approval from these two institutions took 7 months. Written permission to interview faculty was obtained from the administration of the participating program and submitted to the Andrews University IRB and approved. The research protocol was limited to the interview of faculty and the observation of classroom and laboratory activities. Because the study questions are limited to faculty beliefs and practices and the IRB requirements necessary to sanction student interviews and clinical instruction would have added significantly more time for approval, the protocol did not include interviewing students or observing instruction in a clinical facility.

Artifacts and notations collected during this qualitative study may contain information that can directly identify the subjects. These data are kept confidential and secure. The names of subjects, institutions, or identifying links will not be included in any publication of study results. Faculty who wished to participate by being interviewed or observed as part of the qualitative study were required to complete an informed consent form (see Appendix). Prior to every classroom observation, a standard announcement was read to the class informing them of the presence of the researcher, the purpose of the research, and their choice to refuse the observation without consequence.

This study was carried forward with respect for the participants. Subject participation was voluntary and informed. I remain committed to the goal that no individual or organization will be put at undue risk.

In summary, this study involved a purposeful sample, single qualitative case study in which I traveled to the University, observed classroom activities, and interviewed nine
faculty members. The audiotapes of the interviews were subsequently transcribed and returned to participants in a member-check process. Subsequently they were coded and mined for relevant themes using a cross comparative method. The data are presented using the social learning theory framework and a mathematical model with a corresponding metaphor.
CHAPTER 4

RESULTS

Introduction

This chapter is organized into four sections. The first section describes the University as a whole, and focuses specifically on the respiratory program and program faculty. The second section describes the respiratory faculty’s beliefs regarding developing critical-thinking in students. The third section deals with faculty beliefs about effective strategies to develop critical-thinking. The last section identifies the program components that faculty identified as essential in developing critical-thinking.

Eastern Medical Science University

Eastern Medical Science University (EMSU), a pseudonym, is a state institution with a long and distinguished history as a school of medicine. The medical school was founded in the early 19th century. It survived both the devastation of the Civil War and the Flexner Report of 1910, which resulted in the closure of numerous medical schools and a move to close the school for financial reasons soon after the Depression. The University remained solely dedicated to the study of medicine until the middle of the 20th century, when a school of nursing was added. Later, the school of graduate studies, the school of allied health, and the dentistry and Ph.D. programs were added. Degrees from EMSU are highly respected by health professionals.
This research university is located in a city of around 200,000 where the ethnicity of the population is 50% African American and 45% White. Within a mile of the University are two adult hospitals with over 1,000 beds collectively, a children’s medical center with 154 beds, and a Veterans Administration hospital with 278 beds. There are also numerous clinics and health-care specialty centers located in the area including a 13-county level-1 regional trauma center. The University is acclaimed for many significant contributions to health-care as a result of its efforts in research. Researchers from EMSU pioneered the measurement of pressure pulses during cardiac catheterization. They developed a cure for pellagra and achieved breakthroughs in both birth-control pills and beta-blocking drugs. The University’s mission encompasses the reduction of illness in society at large and a vision to become one of the nation’s premier health sciences universities.

EMSU is regionally accredited to award 1-year and advanced certificates and degrees at the baccalaureate, master’s, first professional, and doctoral levels. Each program maintains accreditation by the appropriate accrediting body. It is the only university in the state dedicated exclusively to the health sciences and it is growing. Four new buildings were recently constructed: a research center, a wellness center, an allied health sciences building, and a cancer center.

Respiratory Care Baccalaureate Program

The respiratory care program is described in terms of people, physical resources, culture, organization, and professional engagement. The number of highly qualified faculty is impressive. There are nine full-time faculty members, including the department head, the program director, the clinical director, and the dean of the School of Allied
Health, who is also a respiratory therapist. The department also has two adjunct faculty members and lists four co-medical directors; one is an emeritus professor of medicine. The program faculty and medical directors collectively have seven doctoral degrees. Collectively, the respiratory care faculty hold three Ph.D. degrees and eight master’s degrees. The program also has a full-time office manager and an administrative assistant. In March of 2007 the program had 16 juniors in attendance, three men and 13 women. Typically, about 15 seniors graduate each year.

To house both faculty and students, the University recently built a new allied health building. The respiratory care department, housed within the new building, has nine faculty offices, a conference room, a library, a lobby, and offices for the office manager and office assistant. This complex also includes a staff coffee room, a room for the departmental copy machine, two large storage rooms, a media room, and a research laboratory. A research pulmonary function laboratory is on a separate floor within the same building. In addition, the program has two large laboratory rooms equipped with the latest ventilators and advanced test lungs. These labs are wired with high speed internet and projection systems, and have piped-in compressed gases and suction. A third lab is for simulation, housing radiograph view boxes and high-fidelity manikins. The program also uses a designated classroom for lectures.

The culture of the faculty revolves around a desire to offer the best educational program in respiratory care. This is evident in the pride that faculty and students express in their resources, their association with the University, and their plans for the future. Faculty share a common mission: to change respiratory therapy for the better and
improve patient care. Students, faculty, and staff are congenial, professional, and passionate about their work.

The program is carefully organized to enable success. The student handbook is current, candid, and precise. Additionally, faculty are fully engaged with the American Association for Respiratory Care (AARC) and encourage student participation. Program faculty frequently publish research in peer-reviewed journals, present at national conferences, and encourage students to submit papers and gain membership in honor societies.

Respiratory Care Faculty

This study focuses on the beliefs and practices regarding the teaching of critical thinking by a group of 9 expert respiratory care faculty in a strong program. A background for these beliefs and practices is essentially tied to the experiences and education of the faculty studied. This section gives only a very general idea of past faculty experience because the research guarantees anonymity. Consequently, the names of faculty and many identifying characteristics have been changed. Because the experience and education of the faculty in leadership are substantially greater than that of the newer faculty, and because the leaders have a greater influence upon the program values, these two groups are presented separately.

Faculty in Leadership

All three faculty with Ph.D.’s hold leadership positions, having entered respiratory care during the 1970s. Two of these faculty leaders are men: Associate Professor and Department Chair Dr. Moore, and Associate Professor and Program Director Dr. Purcell. Professor and Dean of Allied Health, Dr. Walker is a woman. Drs.
Moore and Purcell entered respiratory care as on-the-job trainees after completing bachelor of science degrees. Dr. Walker started with an associate’s degree in respiratory therapy, followed by a bachelor of science degree, and began teaching after graduation. From initial entry into the program to achievement of a faculty position ranged from less than 5 years to 15 years for these three individuals. Both Dr. Walker and Dr. Purcell began teaching with bachelor of science degrees and completed master’s degrees and Ph.D.’s while members of the faculty. Dr. Moore did not begin teaching respiratory care until after earning a Ph.D. and completing post-doctoral studies in physiology. Each of these faculty members demonstrated a passion for the respiratory care profession and the role of education in improving the profession and patient care. They were convinced of the value of the educational principles they applied to motivate students and develop critical thinkers and were articulate in explaining the rationales behind them.

Two additional faculty leaders are Mr. McFarland and Ms. Kennedy, both assistant professors. McFarland is the Director of Clinical Education and is currently a Ph.D. candidate. He entered respiratory care through EMSU’s bachelor of science degree in the early 1990s, immediately began clinical teaching following graduation, and subsequently completed a master of science in physiology. He is now working on a Ph.D. in education. McFarland shares the other leaders’ passion for producing the best respiratory care program and the most well-prepared graduates in the world, and he articulates this passion well. He is equally vocal in describing the educational methods that he feels are effective. Kennedy is Director of Admissions and holds a Master’s of Business Administration (MBA) degree. The high number of doctorates and master’s degrees within this program underscores the findings of Ari (2005, p. 66), which
demonstrated better program outcomes with larger numbers of graduate-prepared faculty in respiratory care programs.

**Other Faculty**

Four of the subjects interviewed do not hold leadership positions at the University. Two of these were women, Assistant Professor Ms. Leigh and Assistant Professor Ms. Grover, and one was a man--Emeritus Associate Professor Mr. Yates. A fourth individual, Ms. Clark, referred to herself as “professional staff,” rather than faculty, because she does not hold a master’s degree. While these faculty members do not hold leadership positions, they do have a long history of experience in the respiratory care profession. Mr. Yates entered the profession in the early 1970s. Ms. Grover has almost 30 years of experience in respiratory therapy. Yates holds a master’s degree in education and Ms. Grover a master’s in biology. Each faculty member expressed pride in being part of the University program and held strong opinions on education, respiratory care, and educational methodology.

**Faculty Beliefs on the Development of Critical-thinking**

According to Bain (2004, p. 36) the strength of faculty beliefs is important because: “If the students see you pursuing that [their own enthusiasm for the subject], with all your heart, all your soul, and all your might, they’ll respond.” Teachers have been shown (Marzano, 2003, p. 72) to be very important determiners of student learning. Brophy (1998, p. 22) encourages teachers to look at themselves as their “most powerful motivational tool.” The strength of faculty beliefs is therefore recognized as a powerful director of attention and a determinate of success. Faculty will exert their effort and their influence toward what they believe is effective in developing critical thinking.
Faculty did not use a common phrase to define or describe critical thinking. Neither was there consensus in what faculty identified as the primary method of developing critical thinking in students within this academically strong program. Rather, the faculty agreed that it was everything they do collectively. There was, however, marked agreement among the faculty on the general principles of instruction necessary for the development of critical thinking. For example they agreed that students must be encouraged to “learn by doing,” and that small classes, such as those used in problem-based learning, are most effective. The faculty felt that they limit student growth in critical thinking when they do too much for them or provide them with too much information.

The faculty understand critical thinking to be more than the ability to recite facts. It involves the integration of copious information in making complex decisions. It is a contextualized knowledge that results in success in an ever-changing, fast-paced work environment. Walker says, “I view critical thinking as liberating a human being to excel.” Critical thinking allows a respiratory therapist to influence decision-making in a variety of hospital contexts. It can be difficult for respiratory therapists to adjust to the changing environments in different hospital settings. McFarland characterized this tension by saying, when “you step into one community, they love you; you step into another community, and they don't even know you.” A student or respiratory therapist who is able to engage with physicians and nurses, analyze a situation with people they just met, and provide a rationale that results in a better decision for a patient has the critical thinking that provides expedience. Critical thinking builds confidence-enabling success in new potentially hostile environments.
Critical thinking enables the respiratory therapist to dialog with other clinicians. Clark says:

A program should establish the critical-thinking skills, and the integrity to think about the whole picture, and stand up to the physicians if necessary with justifications on how or why this [a particular action] is or is not what the patients need.

Walker takes this further by saying, people “need to really learn to be effective professionals in how to disagree with someone and still be liked and still have teamwork and rapport.” Critical thinking involves the facilitation of effective group thinking, which benefits the therapist and results in better decisions for the patient.

During the interviews, the faculty described a broad range of elements they felt were important to the development of critical-thinking. The faculty did not show a willingness to limit their discussion to a few critical-thinking strategies. Instead their beliefs represent a holistic view of what is needed to develop critical thinking. The faculty felt that how teachers motivate students to learn by doing was accomplished by using educational techniques such as applying knowledge together, solving problems together, participating in discourse, teaching, and peer evaluations. The faculty also felt that teachers must motivate students when using the strategies of problem-based learning, evidence-based practice, the whole body approach and reflection. They also recognized the contribution of several program elements as required for the enhancement of critical thinking. These elements included the selection and orientation of students, beneficial faculty-to-student ratios, quality clinical education with an integrated curriculum, and special measures to prepare graduates for graduation followed by program assessment.
Motivation

Expert faculty spent a lot of time discussing their own motivation, the motivation of other clinicians, and the motivation of their students. The first section will describe what was said about the motivation of faculty. The following section will describe what is done to motivate students.

A Motivated Faculty

The faculty had a considerable amount to say about their own motivation. Dr. Purcell stated that when recruiting new faculty members, we “try to look for folks that are passionate.” McFarland establishes the importance of passion in a faculty member by adding, they “don’t have to be the smartest or the best but at least have a drive to take care of people.” Moore agrees, saying give “me passion, experience and a willingness to go with our vision and strive for the best.” The general consensus was that faculty cannot motivate students if they lack passion and enthusiasm themselves. To provide contrast, Purcell talked about the poor motivation that can be found in other respiratory therapy programs saying, some “of these guys are probably drier than the dust and some of them are lame.”

Grover recognizes the value of the way that EMSU uses University faculty to provide instruction in the hospital, and this is a motivating factor for her. “I really love the connection between the clinical arena and the students being with the faculty.” The faculty themselves are all motivated to excel. Yates commented on the 5-to-10-year difference between findings in the published literature and the application of this research in the hospital. This motivates him to keep the program up to date. Yates also spoke about other areas that motivate him:
It was very stimulating to learn physical sciences and put the body together. . . . It was pretty fascinating to find out how much of a machine we were, and I was motivated from that standpoint, so I actually loved taking science, and applying it to the body, and making a difference in the outcome by how you treat it.

Some faculty have had dreams of producing better ways of representing and delivering instruction to students. As advances in technology develop, motivation increases as it becomes feasible to make these dreams a reality. Yates has been waiting for 10 years for the technology in mechanical ventilation to advance enough so that he could download the screen on a ventilator and integrate these screens into case-based instruction. “That’s really a fun thing” Yates says. Walker marvels that she gets paid to learn: “Some days when looking at what I am doing in my work and realizing that, you know, I am in a seminar, learning something on genomics and it’s part of my job.” Walker classified this recognition as “a high intrinsic motivator.” According to social learning theory, people learn by observing other people receiving rewards for behavior in what Bandura (1977, pp. 117, 125, 127) termed “vicarious reinforcement.” If students observe the faculty show enthusiasm for what the students are to learn, they are likely to conclude that this learning has been rewarding to the faculty and will be rewarding to them as well. Passion and motivation are key (Bain, 2004, p. 78) to the best teaching. Faculty will be more successful in motivating students to learn to think critically if they are motivated themselves.

**How Faculty Motivate Students**

According to Dewey (1939, p. 618), “the problem of method in forming habits of reflective thought is the problem of establishing conditions that will arouse and guide curiosity.” In preparing for a class, the best teachers (Bain, 2004, p. 49) think about what they can do to help and encourage students to learn. Researchers recommend that
teachers take actions (Marzano, 2003, pp. 149-151) to enhance motivation and not expect that it will simply happen. The faculty in this study did not believe that student motivation just happens, rather they give serious thought to how they can best motivate their students to excel and become critical thinkers.

Faculty believe that several methods best motivate students. For instance, they believe that candid feedback motivates students to honestly evaluate their thinking and progress. When students successfully finish challenging critical-thinking assignments they are motivated--especially when these assignments were initially frustrating. The faculty believe that it is motivating when students can see the effectiveness of their critical-thinking approaches. Even though the assignments are tough, they know the difficulty will help them achieve growth as practitioners. Generating strong emotions in students is also considered motivating, and faculty want to help students develop a fascination with the application of critical thinking. The faculty aim to keep the intensity of assignments at the right level, providing recognition and incentives for participation. Prompt feedback motivates students taking classes by distance learning.

As a means of motivation, Purcell tries “to be real honest” with his students. He aims to “give them confidence” and “boost their self-worth.” He says, my “job is not to make them feel bad or belittle [them] by any means.” He does wants them to earn this confidence and to have it because they deserve it, rather than as a result of flattery. He will not tell them, oh, “you are wonderful” when their work is not meeting the high standards of the respiratory program. He points out their mistakes, but also makes sure to praise exemplary work. He gives “specific feedback” and tries to keep it as private as possible, but he is not afraid to tell the truth and enter into an honest dialogue. He
believes students appreciate that he is up front with them and that it helps their personal growth, gives them an accurate sense of where the bar is, and how close they are to achieving good results.

Faculty make fairness a priority in dealing with students. Purcell gives the example of imperfect test questions, and says he will always favor the student and discard a disputed question: “A bad question is a bad question.” Purcell also allocates partial credit on tests to encourage this sense of fairness and motivation if the student can give him a logical argument to explain a particular answer on a test that he would otherwise perceive as wrong. Even if the student’s argument is not perfect, but “they are showing logic and reason and good thought,” because reasoning, logic, and good thought represent the foundation of critical thinking and in order to encourage critical thinking, Purcell will give them partial credit for the answer given. Students sense this attitude of fairness and it motivates them to try to communicate the basis for their assumptions, creating a bond of loyalty to the faculty member. When a person first tries to ride a bike or drive a car there can be a temporary period of frustration before the skill is mastered. Likewise, if a student is unaccustomed to the challenges of critical thinking, trying to overcome them can be frustrating. Once the critical-thinking challenges are surmounted students are attracted to them. Moore says once the students “get over the frustration they come to like the process.” The students recognize that the faculty member is there to help them, which is motivating. For this reason, it is very important that faculty care is genuine.

Good instructional approaches are also seen as important in motivating students, and many of the faculty have specific techniques they are passionate about. Moore provides an example by saying, my “passion is that I am going to ask them questions.”
He lets the students know that he is “not going to read the book back to them.” He insists that they put the information in context. He makes it clear that it is very important for them to know the information in the text. Moore says, “I care less about the ‘what’ than the ‘why’” He also cares about the how—as in students will apply the information in the context of patient care. It is this ability to not only understand the research and the physiology behind knowledge but also the ability to communicate these rationales in the clinical setting that make up the critical-thinking objectives of the program.

What drives the way the faculty organize education is their sense that it is the highest priority. Moore rhetorically asks the students, when “you graduate from this program, if I come to the ER and see you in the room with my child, will I say ‘OK’, or I am I going to watch?” He then answers his question, you “will not get out of the program if you cannot pass that kind of muster.”

Faculty said that they used peer review, with students evaluating the participation of their partners on a common assignment. These peer evaluations became part of the students’ grades. Using a system like this is important for the development of critical thinking because when it works well it increases the quality of each student’s participation in the group. It also compels students to “learn by doing” in critical-thinking activities at a level similar to what would be expected of them in the hospital. That is, they will need to use candor and sensitivity to communicate their view of a situation when there are potentially emotional ramifications for all involved. Because students have little if any prior experience with this kind of peer review, they have a tendency to score their partners leniently, or complain about the process. The potential for emotional resistance such as this makes the implementation of peer review difficult. When
discussing the difficulty of faculty implementing student-to-student peer review systems, Moore said, “I think you have to have a fire in your belly for that” because it is such a hard thing to do. There is much to learn in respiratory care and without the benefit of passion and emotion on the part of the student, the information could be forgotten or become boring. In light of this, Moore aims to generate emotions in his students, “When they have pain, joy, anger, sadness,” whatever their emotions and frustrations are, he thinks to himself, “Now I got you.” Because it can be challenging to initiate student peer review and to generate emotions in the students, the faculty are conscious about the role that their own passions and convictions play in the process.

Providing a scheme that will help students understand the body excites Yates. He said that even students with good grades “are not that motivated” and as far as being ready to actually apply themselves and think critically, he says, “forget it.” Yates feels that the students are probably excited to be in a professional program with high levels of responsibility and technology, but they lack the commitment to learn difficult concepts and make sense of large amounts of details and data. Students who become enthusiastic and fascinated with how things operate are the ones the faculty see as most likely to be successful. It is the recognition of beauty, interest, and a sense of discovery that Associate Professor Yates identifies as key motivators.

When a subject such as mathematics is kept close enough to its application, its value is recognized and people are more likely to be fascinated. A problem with instruction in mathematics is the observation that it is often too far removed from its application. Once students are able to find its application, however, they are more likely to love it. Significantly, faculty use emotional words like “love” and “hate” when
discussing the learning activities they create. This is because “emotions play a prominent role in motivation” (Marzano, 2003, p. 147) and can “chart the course of moment-to-moment” actions. The fact that faculty frequently name the emotional responses of their students to learning activities provides a confirmation that they are tracking these motivational interrelationships.

Blevins showed her attention to motivation when she communicated her worry about class pacing. She worried that her class pace was too slow to keep her bright students motivated when she says, “I almost make it so slow that the top percent of the class are bored.” Blevins did not present a solution to her concern but her comment illustrates an attentiveness to how course delivery affects motivation. All the faculty pay similar attention to the motivational aspects of learning activities.

The faculty found that when they gave the students loosely organized problems that the students needed to clarify and research, they still needed to proscribe certain parameters. Kennedy said, “And we found that if we don’t give them deadlines, they will do it too late.”

Participation in class is another important motivator. Kennedy’s students are required to post observations online as part of the participation element of the class. Classroom participation is also carefully tracked and graded by Moore. He related how his class wanted recognition for their participation. He said they wanted him to say, “Bam” when they answered a question well. “It started as a way to ease the tension of answering a question and stuck.” Moore recognizes the necessity of an expectation of participation; you “will have everybody fill up the back seats first. It is like the back seat of the churches.” He does not believe that you will achieve a meaningful conversation
without requiring full participation from students. In one syllabus, attendance and participation counted as 10% of the final grade, while in a second syllabus it was not mentioned in the course grading scheme. In one case, the students did not want to go to a state conference. While not forcing the students to attend, faculty gave such a difficult alternative assignment that the program had 100% participation. The conference was actually greatly appreciated by the students who were glad that they went. Moore explains, all “of the sudden they get some hands on laboratory, and they hear people and they like it.”

Because of the Internet, web-based education provides easy access to learning materials and faculty feedback. This proximity can help motivate the student when off campus. Web-based resources are provided for examination review. A problem-based learning (PBL) course has been converted and placed online. All classes are videotaped and quickly placed online for students to access. Faculty are working on placing courses online. Distance education technology is seen as a method whereby programs can share resources and complement each other. The faculty in this program see distributed learning as a way to complement other learning activities.

The program celebrates the required community service students provide in asthma camp. In the spring, children with asthma travel to a resort and the respiratory care juniors plan for this. The juniors take part as counselors, they organize the asthma self-care educational sessions, and are able to participate in the assessment of the campers and their medical care. Grover uses asthma camp as an example of the kinds of challenging activities that result in a motivation that springs from student pride in what they do:
We allow them to go out there and get this done and shock us and then they come back with that little bit of wow. . . . And so its stressful and they resist but when it’s all said and done they come back going ‘Wow’.

Program faculty are concerned about the internal motivation of both faculty and students. They work to foster internal motivation and are not afraid to use external sanctions and rewards to pressure students into doing what is needed. They recognize that external motivation or force is sometimes needed to get the students to do the right thing. In the above examples, students became internally motivated by the challenges presented.

Learn by Doing

The faculty are unanimous in maintaining that students do not learn by being given too much information. Students do not learn by being told what to learn and how to think about what they learn. Students learn by doing and by looking things up (Bouton & Garth, 1983, p. 78; Caffarella & Merriam, 1999, p. 224; Ceconi et al., 2008, p. 58; Kuhn, 1996, p. 47; Tyler, 1969, p. 39). When it came down to learning McFarland said, “When you actually do it in the clinic” everything comes together. Clark also maintains that there are people who learn better by writing or hearing or seeing, but she continues, “I think the predominant method of learning is by doing.” Kennedy pointed out that faculty can only present so much information and that students need to look things up themselves.

Learning involves a lot of work for both the faculty and for the students. Students must participate in class discussions in order to gain the greatest benefit from instruction. Rather than simply being handed information, students must read and discuss it. Kennedy also says, “Listening to a lecture is one thing, but I learn by doing.” Even in the clinical setting Clark continues the same train of thought when she says, “I am trying to structure a lot of my questions around critical-thinking.” When she has a patient in distress she
asks the students about the temperature and the blood gases, and then she tries to have them tell her the next step, “rather than me telling them.” She tries to have them work through what they think is going on with the patient.

Purcell views lecturing as an instructional methodology that is tedious and from which people retain very little; “I don't expect them to focus every second on what I say.” Kennedy adds, “Just sitting there and listening to lectures is boring.” Clark has personally experienced greater learning retention from PBL: “I really did retain that information more than from a general lecture.” Yates went as far as to brand lecturing as a waste of time. Walker made a similar point:

Just because a teacher is up there talking about facts does not mean your student learns a darn thing. So we tend to think that if we are teaching it, people are learning it. You are wasting time, yours and the students.

It is a paradox that while each instructor does some lecturing it is still described disparagingly and considered by many to be a waste of time. It appears that the faculty are either using hyperbole in their reactions against the lecture model or are constrained by tradition or policy to follow the common university practice of lecturing. Perhaps the faculty communicate the ineffectiveness of lectures to help themselves focus their efforts toward the inclusion of learning strategies known to develop critical-thinking.

Lectures are video and audio recorded so that the information can be accessed later in recognition of the fact that students are less likely to retain information heard once in a lecture. PowerPoint slides are developed prior to class and those submitted demonstrated multiple high-quality illustrations. Some included selections by medical illustrator Frank H. Netter. Expert faculty also use Socratic questioning and student participation, their designated “lectures” providing a higher level of interaction than that
found in many lecture-based classrooms. Faculty frequently use technology to keep the students’ attention, even if this involves some level of entertainment.

**Effective Strategies to Develop Critical-thinking**

Critical-thinking educational strategy is defined as “patterns of instructional effort” (Koepke, 1993, p. 11; Weissman, 1990) designed to develop critical thinking. These patterns include complex sequential and recursive educational activities (PBL) made up of a number of exchangeable techniques such as questioning and peer review.

When expert faculty were asked to describe the primary strategies their program uses to develop critical thinking, they listed one complex well-studied learning strategy (PBL) which is very similar to the cooperative learning structure Co-op Co-op (Kagan, 1992, pp. 19:2-19:7). They also described evidence-based practice and the whole-body approach. The latter two have not typically been described as educational strategies. The faculty also use reflection and several educational techniques.

While a number of strategies are used to develop critical thinking, the ways that they are implemented are consistent. The strategies are implemented with student access to large amounts of literature, computers, laboratories, and attentive faculty. They are completely organized prior to implementation and the organization is designed to require the student to be active and accountable. Students must make recommendations and then verbally provide the evidence or reasons for those recommendations.

**Educational Techniques**

The faculty said they do not advocate only one strategy. The educational techniques included applying knowledge, solving problems together, discourse, teaching, peer evaluations, and answering questions.
Applying Knowledge

Students must apply and explain how they apply what they have learned to real problems even though this is difficult (Stice, 1987, p. 95). Purcell said that they try to test at least using application questions, “not pure memorization questions.” They give the students exercises and tests that involve thinking through solutions to problems and application questions. Purcell balances this by saying, “On the other hand I just gave them a test and if they could not give me five ways to assess that they have intubated then they are missing points because, there is more than five anyway.” The rationale that he provided is the importance of the topic: “They are the experts in airway care and if they don't know how to tell if they put the tube in the right place, that's nuts.”

Balancing this were the statements by Yates who considered memorization to be a pretty basic requirement for anyone entering respiratory care. He maintained that it is impossible to think critically without data to think critically about, “I mean, it’s a necessary function to memorize stuff. You’ve got a library up there to draw data from at will. If you don't memorize . . . , you don’t have any data to bounce ideas off of.” Yates gave the example that if a patient has a saturation of 90%, the clinician must know immediately that this is associated with a PaO2 of 60 torr. Overall, the faculty recognized that students must know basic facts and information, but they do not want to have their instructional time monopolized by the learning of facts. Walker says, “If there are facts that need to be learned, figure out how the student is going to learn them, not you talk about them.”

When students graduate they will need to function independently of the program and program faculty. When students ask Purcell for information he rhetorically asks,
“What makes sense to you?” then he provides an explanation for his question by saying, “Eventually you are going to graduate and I’m not going to be here.” Then he tells them that they will have to learn how to make their own decisions. Leigh maintains that students need to be responsible for their own processes of finding information to learn. She contrasts this with giving the students “too much so they don’t have to search for it” and “they don’t have to get an understanding for it.” But she says that in this program the students do gain an understanding because of the way faculty deal with questions. The students are told, here is what you need to know and how you need to know it, “but you tell me why.” Students are told to come back with good input and then the students and faculty will talk about it. This discussion will include everybody’s perspective so that they learn from each other and from the instructors.

**Solving Problems Together**

Students need the ability to use their own minds to analyze problems, developing and implementing solutions to those problems. For this reason the program does not want to give the students all the objectives, which would rob students of the opportunity to determine what is important for them to learn. Telling them exactly how to do an assignment would rob them of the intellectual work of solving a problem. There were many different places in the program curriculum where faculty may appear callous or disinterested, because they purposefully withhold the information that the student requested. Clark said that rather than handing students information, they “must read and discuss, so it sinks in better.” Purcell states that this does not suggest laziness on the part of the faculty, because it is in fact much easier to simply provide the information and placate the student. As part of PBL sessions the faculty encourage the cooperative
learning technique (Johnson et al., 1991, p. 3:12) of small-group processing, with the students giving feedback to each other regarding “whether they are getting what they think they should get.” Purcell says that the faculty “has the very difficult role of sitting there and not telling them what’s right.” Kennedy feels that it is more work for faculty to encourage students to organize questions, seek data, analyze data, and then propose and implement solutions. She says that they break up the class into small groups with three to four facilitators and that this is a “big drain” on the faculty’s time. “But it is worth it,” Kennedy says. According to her, every year the faculty ask the question “is it worth the effort?” It takes far more skill to say, “No, for your own good, you need to do these things.” It means that the faculty must repeatedly explain that students are responsible for obtaining information. Purcell said the faculty always encourage the students. The use of the term “encouragement” reflects a faculty attitude that does not communicate a demeaning, superior, or patronizing attitude. Though the faculty members require students to function in a way that is new, students are not abandoned to the task; rather the faculty encourage and support them.

The faculty are determined to give the students exercises and assignments that require them to analyze, apply, and synthesize answers to the types of challenges that are typical of respiratory care practice.

**Discourse**

Students learn better when they can teach the information. If all that you do in class is test recall knowledge, then people come to believe that the person who has memorized a lot of facts is the one who is smart. Walker puts it this way:

Our students know things we don’t know but if you just sit them in a classroom and you don't interact with them and they don't interact with each other, everyone sizes up
each other, he is a dummy, he is a whiz and usually the kid that knows all the facts everyone just assumes is the whiz.

According to Walker, these people may not be the best clinicians because they may not know how to interact well with others. These students need to have their facts challenged and learn through a give-and-take process with other students and faculty. Other students may demonstrate other abilities in the clinical setting that are just as valuable:

The reality of it is that it is not just facts that you know, it is interaction with people, how you communicate in writing, speaking, how you listen, how you size up a problem, a situation, so our educational system needs to incorporate all the important qualities, and respiratory care has acknowledged that for a long time because we have the cognitive, psychomotor and we had the sense to include the affective domain.

Educational strategies and assignments that are likely to generate discourse or “academic controversy” in cooperative learning (Johnson et al., 1991, p. 7:1) are regarded as essential by all faculty. Discourse is a special kind of communication between individuals who have different perspectives. Discourse is not a debate in which participants seek to win, it is rather a win-win dialectic in which participating members seek to find and improve understanding. The reason that students must learn to discourse is because this type of communication between clinicians will help to identify and prevent the erroneous treatment of patients. Part of what faculty do to generate discourse is to picture complex scenarios, the types of unstructured problems that are found in real life. Another approach is to require students to participate in peer review activities that are bound to uncover differences in belief and knowledge. Additionally, students make presentations to each other and to asthma camp students. Frequently students must answer unexpected questions when making presentations, and this gives the student practice in answering the kinds of unexpected questions that arise in the hospital.
Several faculty said that students have to learn to communicate with physicians. Clark said this “would be very big” for the profession. Yates says, “They’ve got to discourse with doctors.” He continued, “They really have to know the subject inside and out.” He went on to contrast knowledge of the subject inside and out with just “being able to do the right thing.” When Walker describes their program training, she says, “Students interact with physicians and not just in the cliché way that CoARC requires physician interaction. Students have to speak at the bedside.” She went on to say that they have strong physician support to the extent that the physicians know what the students need to know and “they take the time to ask the questions to make all those novices think of how you go about showing what you know in a professional [manner].” Moore also speaks of the necessity to prepare students to communicate with physicians. “We have to be able to speak physiology to the physicians because that is what they want.” This goal was given as a rationale for having the students be able to support their positions with appropriate research and journal articles and being able to reference physiological interactions. Kennedy says, “They have to find an article that will support” the recommendations you make to “the physician.” Preparing students to effectively communicate with physicians is an important goal shared by all faculty.

Students need to be able to articulate the rationale for their recommendations and know the information well. Walker says, “The students are required to give presentations, to participate in debates where they argue for and against.” An even higher goal was that students need to learn to disagree with someone and still be liked. According to Walker, “people need to really learn to be effective professionals in how to disagree with someone and still be liked and still have teamwork and rapport.”
Co-Peer Teaching

Consistent with the Cooperative learning technique of co-peer teaching (Millis & Cottell, 1998) Purcell said that the best way to learn is to teach; “Oh, that’s the best way to learn something is to teach it.” Because of these goals the students are required to write and give presentations. The program faculty are purposeful in requiring the students to teach, present, and communicate as a means of helping them to learn.

Students do a lot of presentations and the program focuses on presentation skills. Teaching is believed to be one of the best ways to learn, and students are given opportunities to practice being teachers. Students are said to be given loose guidelines on how to structure presentations. Initially they may do poorly but through seeing other students’ presentations and participation in critiquing, they improve. They begin presenting in small groups in the PBL sessions the very first semester. They also present a research article and research projects in the research class. They put together a panel discussion on Acute Respiratory Distress Syndrome (ARDS), and they participate in debates where they argue for and against. Purcell felt that his test reviews were one of the best methods whereby students developed critical thinking. In the test review the students had an opportunity to argue for and against their answer or the nature of a test question. He views the test review as so valuable that he was very much disposed to provide students with points for a good argument even if the answer was not entirely correct. The reason given was that he wanted to encourage this ability and desire to interact in the search for knowledge. As previously mentioned, Grover described an additional assignment, where the students organized the asthma camp:
Juniors are going... We are requiring them to prepare for asthma camp and it is their responsibility to prepare all the activities for five days. We are just going to be there to oversee it, just one or two faculty.

For the asthma camp, the students must develop the curriculum, come up with the games, and act as camp counselors. The students do not have to present at national meetings or to physicians, however. The contexts of the presentations are kept low-key so that the students are not overly stressed, but they are all evaluated.

**Participating in Peer Evaluations**

Cooperative learning (Johnson et al., 1991, p. 2:7; Kagan, 1992, p. 19:7) stresses the importance of peer evaluation or feedback. Students evaluate each other in the research class, and the faculty take these peer evaluations into consideration when calculating a student’s grade. Purcell will not allow the peer evaluations to lower a students’ grade, only improve it. Students are given a Likert scale to use in peer evaluations. Moore talks about the importance of students learning to take responsibility for someone else’s work:

> Why not start early with the students to start finding ways to make them understand that it is better for them to get a B on a project, then it is to hurt somebody because they aren’t holding their peers accountable, because they are not taking responsibility for something that somebody else might have done. That, to me, is the highest order of what our patients, our customers, need to get from us.

Faculty required that students do an honest peer review, as opposed to one that glosses over the performance and reports that everything the student did was good. Moore shares how he accomplishes this with students who are uncomfortable with the process:

> After one team assignment, I had a student come to me and protest the fact that they/he got a C. He got the same grade as his partner. I asked ‘Well why do you think you shouldn’t have got that grade?’ Well because I did all the work and I did this and all they did was . . . ’
Moore responded to this student by observing “Oh, well, ok, you did an evaluation on your partner.” Moore pointed out that the student had given his teammate a strong evaluation. “Which one is accurate—what you are telling me now, or the fact that you put on this paper that you shared all the work equally?” The student confessed that he hadn’t wanted to give negative feedback. Because accurate feedback is so important in clinical care, Moore continually pushes his students toward honesty, “You have to call it the way it is. You are going to be interacting with doctors; you are going to be held to your word. And, so I am holding you to your statement here.” The peer review process offers a lot of advantages in respiratory care education, but honest, effective peer review is not a learning activity that students come prepared for. For peer review to be effective, the faculty believe it necessary to continually clarify expectations.

**Answering Questions**

Questioning by faculty that will make the students think is considered by Yates, Purcell, and Walker to be one of the primary ways in which students are taught to think critically. Yates said, “To talk is number one and the biggest thing in my mind that you can do is to quiz, to get people to talk, and to get people to think.” Many instructors spoke of the value of faculty questions. According to Purcell, “I like to ask ambiguous questions.” “I like to ask questions that there is no real good answer to.” With his questions, there is often “no wrong answer.” To answer these kinds of questions the students largely need to be able to show that they think about what they are doing. Purcell believes that it is helpful for students to argue in favor of the answer they chose during a test review: “I will give the students the opportunity to argue any question except for ‘I’ve got to get credit for it.’” It is viewed as helpful that the student may have the
question marked wrong so that afterwards, during the test review, they will argue for the
answer they selected. Purcell maintains that they all do a lot of asking, “So what does that
mean?” and, “So what?” When students ask a question, the faculty will refrain from
giving a concrete answer, saying instead “That’s a good question, what do you think?”
The faculty deliberately write exam questions that have to be read carefully, requiring the
students to pay attention and think. Students will not always read these carefully, and
then Purcell will make the point to them that this is a crucial part of their training: They
have to read doctors’ orders carefully. Initially, this explanation might upset the students,
but later they recognize that they are not reading the questions carefully and they will
take the advice to heart. In class, faculty will call on students to see if they are paying
attention. Dr. Purcell refers to a student to provide a current example, “There have been a
number of times when she has been disengaged, checking her fingernails while he
lectured.” Sometimes he ignores the behavior, but other times he uses it as an opportunity
to call on the student and ask them a question. He has also called people aside after class
and said, “You don’t look very interested in what I am doing. When I look at you, you
appear to be looking around and paying no attention. Is that accurate?” Rather than
coming across as accusatory or judgmental, Purcell tries to phrase his questions so that
students can clarify whether his perception is correct or not. He voices his own
limitations by saying “Sometimes I am better at that than others.”

It takes a while for faculty to learn what kinds of questions to ask. When students
make a discussion post faculty will ask them, “Where did you get that?” Additionally, the
faculty use questions to help students prepare for their credentialing examinations. When
faculty provide clinical instruction they constantly ask questions that tie what is
happening in clinical to what has been presented in the didactic curriculum. Oral quizzes are considered to be number one, and therefore small-group interaction is necessary. Students have to tell how and why something is the way that it is. The faculty believe that they have to ask questions from every angle in order to ensure that students understand the material thoroughly and have the ability to apply their knowledge in a clinical setting.

Faculty believe that it is active discourse, more than anything else, that develops the abilities to critically think and communicate with others while learning the facts. The faculty use problem-based learning in which the students develop an evidence-based medicine and a whole-body approach for understanding and communication. Problem-based learning is a strategy that originated in medicine. Students are closely guided by faculty members to determine their own learning issues, which are the questions the students want to find the answers to. The students then conduct their own research to address these learning issues, share findings, and identify new learning issues. Evidence-based medicine is the current practice of identifying the level of research supporting medical practice. The whole-body approach is the practice of describing the physiologic interactions resulting from one or more interventions. Integrated with the problem-based learning approach are the requirements that the student verbally communicate findings and enter into discourse with other students and faculty as their assumptions are questioned.

Problem-Based Learning (PBL)

Problem-based learning is a learning strategy that breaks a class up into small groups and uses a patient case or scenario, the features of which are progressively disclosed to stimulate the identification of learning issues. Each group has a faculty who
facilitates group processes and provides the patient data. Group members identify learning issues and assign responsibilities for research to group members. Individuals research the questions at home and come back to the group to make presentations on what they learned. Group members question each other and rate each other’s contributions.

The use of PBL is a program decision that is reviewed every year. It is recognized as very expensive because a number of faculty are required for each class meeting, it is time consuming, and not an efficient teaching model. Walker says, “We have to question, can we really keep doing x, y and z?”

New faculty learn the PBL model when they come because it is part of the program’s educational philosophy. One faculty felt that PBL worked better with a bachelor of science program because the students needed to be prepared and motivated to think a problem through. McFarland says that “they need to be at a place where they desire to think through a problem.”

One faculty member said that students receive very little guidance. This statement needs to be balanced with an understanding of the amount of faculty support students receive. According to Kennedy, the whole class is broken up into three or four small groups. Each small group is assigned a facilitator, requiring three or four faculty to be present at each class. While this is a big drain on the faculty’s time, it is viewed as “worth it” because the method is considered to produce better learning outcomes. Students have high levels of faculty support but they are given less guidance than they are used to receiving. Students are actually characterized as hating the problem-based learning class until after they graduate, when they recommend it. In Beachey’s (2004) dissertation, one
of the only findings that differentiated outcomes of PBL programs was that graduates felt the instruction was more “humane,” probably meaning more personal or humanistic. Ceconi et al. (2008, p. 60-62) demonstrated positive correlations between credentialing examination scores and the implementation of a PBL program. Students are also characterized as disliking the online version of the class because it is a lot of work. A good example of these students’ feelings is represented by a student who later became a faculty member. Clark said, “As students, we felt like we are paying for the faculty to teach us, not just to tell” us what to read and for us to teach ourselves, “but looking back, it was a good method. I really did retain that information more than from a general lecture.” Clark remembers reflecting as a working therapist that PBL really seemed to work.

According to McFarland, students initially do not know what critical-thinking is, and they do not understand that they are not already thinking critically, “even when you tell them and you show them examples.” When students are divided into small groups there is an advantageous faculty-to-student ratio. Students are given a scenario and then they are told to identify what they do not know about it and what they need to know to be able to understand it better. Then they are required to go out and get the information, bring it back, and present it. They decide what is important to share. The students must evaluate the credibility of the sources in harmony with standards of evidence-based medicine. McFarland says that students are supposed to teach as an integral part of problem-based learning, “so if they really want to learn it, they have to be able to teach the class.”
Subsequently students are required to give each other feedback. Purcell adds, “We encourage the students to give feedback to each other” and this is done so that the presenters know whether they are presenting what they should. Even in the hospital, clinical instructors use the approach of not telling the student the next step. Here Clark asks them, “What do you think you should do next?”

The faculty believe PBL is a good introduction to the world. The program understands PBL as producing students who are better at the things they are required to do in the workplace, creating better patient outcomes. But the connection between PBL and better patient outcomes is not something that researchers have found a way to measure. Walker pointed this out by saying that the best studies say they “do no worse” on academic measures. But she says that they are better at those things that involved the everyday workplace. I believe today, Walker would cite Ceconi et al. (2008) as evidence that improved outcomes may be expected when PBL is implemented correctly. She said that “it is the things in the everyday workplace that” make a difference in patients’ outcomes. And she continues by recognizing that “we still are not very good at measuring” how the everyday interactions between the caregiver and the patient affects outcomes. Roles are emphasized by all faculty. The students’ job is to learn the information and not blame the faculty if they do not learn. The faculty’s job is to present information in an intelligent fashion. If it is not understandable to the student, it is the student’s job to tell the faculty this is the case.

PBL is recognized as an expensive learning strategy currently without clearly demonstrated patient-outcome advantages. Faculty still believe that it is an important method of establishing the students’ ability to communicate, find information
autonomously, and think critically. Studies published recently in respiratory care demonstrate an advantage in credentialing exam performance.

Evidence-Based Practice and the Whole-Body Approach

Two individual faculty members reported two systems which they characterized as the primary method of developing critical-thinking. These systems are used and introduced in the PBL course and then used throughout the remainder of the program. These systems are evidence-based practice and the whole-body approach. Grover asserts, “I think we emphasize more than anything evidence-based practice.”

Evidence-based practice and evidence-based medicine is a system whereby the methods used to treat patients in the hospital are established on research. This is important to respiratory care because the therapists need to be able to justify decisions regarding patient care through research literature. Kennedy said, “They have to find an article that will support what you want to do with the physician.” When expert faculty say that the program uses the evidence-based practice method of teaching critical-thinking, they mean that students must be able to back up their positions and recommendations with research, and that they are taught to evaluate the level of support reported by the research. Here is how Grover puts it:

How do you read and compare? You look at the methodology, you look at the empirical evidence that is out there and you ascertain whether it is credible or not. . . . We keep bringing them back to, what evidence do you have to prove that? Is that a credible source? . . . Was this acceptable to a peer-reviewed journal?

Evidence-based medicine or practice is one system that the program uses to help students critically evaluate the credibility of a position.
The whole-body approach does not exclude or compete with evidence-based medicine. It is a complementary system that Leigh said was a primary method used to teach critical-thinking. The ability to speak about the effects of one intervention on the other parts of the body based upon established physiologic relationships is what Leigh is speaking of when she says “the whole-body approach.” For instance, the initiation of positive pressure mechanical ventilation increases the mean intrathoracic pressure, which impedes venous return. This reduction in venous return results in a drop in cardiac output that further results in a reduction in blood pressure and subsequently urine output. A drop in urine output results in other physiologic changes and homeostatic adaptations. A familiarity with these homeostatic interrelationships across the lungs, the heart, the brain, the kidneys, and other organs forms a physiologic basis for counterbalancing therapies. As with evidence-based practice, this is a method of presenting the basis of one’s beliefs and recommendations in a way that is familiar to and consistent with the language of physicians and others who practice health care.

Reflection

Students are introduced to the idea of reflection at the very beginning of the program during the PBL course. Purcell says, “One of the big things that we talk about is reflection.” Students are told to think analytically about what they are doing and develop the ability to communicate why it is right or wrong. Mistakes are acceptable, but part of the reflective process is to ensure that students do not repeat the same mistakes. Reflection is not taught using an overt process that is talked about, instead assignments are given that induce reflection. Students are encouraged to reflect in the process of taking departmental comprehensive examinations, where they are not told what answers
they get correct or incorrect. Reflection is part of the midterm and final clinical examinations. Kennedy described what occurs in clinical: “We have to do an evaluation of the clinical performance at the end of the clinic. And, you know, that is a way for them to reflect, and I think that's one of the major tools.” Clark gave another example of reflection in clinical, “I try to say . . . ‘ok, today you saw active abdominal expiration,’ and I will try to have them write down the one thing that they learned.” In contrast, Grover said that the rigor of the program resulted in not having “as much time for reflection.” The concern is that when students and teachers have too many tasks to perform or too many topics to cover, there is insufficient time for putting it all together. If a faculty member does not also teach in the clinical area, reflection is thought to be hampered. Reflection is considered to be a large and important part of learning, and the general view is that there could be more reflection built into the curriculum than there currently is. Walker noted, “I use it [reflection] in almost everything I do.” Faculty are intent on creating room for reflection by the students because critical-thinking often requires time. It may require a significant amount of time when a student first thinks through important physiologic relationships. As students move from novice to advanced beginner they will be able to recognize relationships more rapidly, but at first it is time-consuming and requires patience. For students who are mainly used to memorizing facts it can be hard work to think critically and to see how the facts are interrelated, so time for reflection is important.

Writing and speaking provide reflective opportunities for students to learn to think critically (Van Horn, 2000, p. 130). Faculty also view writing as a practical method that students can use to gain recognition in the profession. Students write a paper early in
the program on a subject of their choice, and write about learning issues as part of the online PBL class, and they must support their positions with references. Walker says:

All of our students should be doing this [writing a paper] and early in their career, and we just changed the curriculum to where the students do that and then we encouraged them to take those papers and apply for scholarships.

Many staff therapists are said to be deficient in writing, and the program therefore has an interest in producing graduates with more skill in this area. The program’s students have won several awards, indicating that writing is being well taught. Walker says, “A lot of staff therapists have good questions and do good work, which solve problems, but they tend to be anecdotal and it’s the writing piece that is missing and [using] a studied approach.” Writing assignments should be appropriate to the level of student. For instance, it cannot be expected of freshmen to write as well as bachelor of science degree students, but they should still have papers to write. Writing enables students to take more time to examine their own thoughts. When students write, the thought is more permanent and it can be analyzed carefully. It is easier after writing to identify weak or incomplete thoughts. Sharing writing with others can help students to see when they need to rephrase an idea. Students retain by doing and something that students can do is to write.

The faculty are determined to give the students exercises and assignments that require them to analyze, apply, and synthesize answers to the types of challenges that are typical of respiratory care practice.

**Program Components That Develop Critical Thinking**

The expert faculty emphasized the importance of various program components in supporting the development of critical thinking. The faculty actually saw a link between the prerequisites required in the program and other similar program components and the
ultimate objective of eventually developing critical thinkers. When asked about the teaching of critical thinking, they spoke broadly about this prerequisite education, student selection, orientation, numbers of faculty, program improvement, and how clinical education is provided. In this way the faculty could think of the program holistically like they thought of the human body as many different organs that are interdependent and important to the functioning of the whole.

Prerequisite Education and Student Selection

Faculty were unified regarding the importance of prerequisite education and careful student selection, but Walker articulated this best during the interviews when she said:

What works really well is to set prerequisite courses and I believe a minimum of four [college] courses [is needed]. More if you can negotiate it through the system that you are in. Students have to have the fundamentals of English 101, Algebra, Basic Science, Physical Science even.

The faculty voiced concern about an open access style of education attributed to technical colleges offering associate degrees. At the same time they said that the bachelor of science program of which they were a part was fortunate in that their students had already completed 2 full years of education before they qualified for matriculation. Walker said, “We have the ones who have already successfully passed all those introductory courses.” Even with the program prerequisites strictly enforced, some students were significantly challenged by the critical-thinking challenges inherent in good respiratory care education.

Several faculty have found that students are not as prepared as they had hoped. Yates observed that even “students with so-called good grades that come in here” are not good thinkers. McFarland also complained that many students
don't even know that they are not thinking critically. They do not realize that they are not thinking critically, even when you tell them and you show them examples. It takes them time, too, to actually speak with critical thinking concepts. Where they come to realize, ‘Oh, this is what critical thinking is about!’ they have not been groomed for critical thinking in their preparation.

Purcell spoke with apparent envy, saying the situation would be better if they had students who had completed the premed program at college: “I wish we had those medical student rejects from the university but we don’t.” Faculty also complained about grade inflation, even students with high grades who had completed 2 years of college prior to entering the program still had trouble with the levels of learning required. Walker said:

Students come to us today that have A averages and are juniors in college, but they are weak in their basics, especially algebra and math abilities. And you wonder how did they earn these grades? So there is, I think, degree creep and grade creep.

The importance of prerequisite education and grades has been underscored by publications in respiratory care (Ari, Goodfellow, & Gardenhire, 2008) that demonstrated the strongest predictors of student scores on the CRT and the WRRT as science grade point average and cumulative grade point average. In another recent study, Andrews, Byington, Masini, Keene, and Burker (2008, p. 50) suspect that “a limited or unrealistic expectation of the demands of a respiratory therapy program may be one of the largest contributors to attrition.” Faculty recognize the possibility that students could enter the program and be unsuited for it. Walker asserted, “The sooner you can” help them “find some other career path” the better, but do not let “them just flounder.” Faculty recognize that many students still enter the program inadequately prepared and are eager to begin a process of orientation where student expectations are aligned with program realities.
Orientation

When an educational program uses methods that the students are unaccustomed to, it is very important that the students are told what to expect and why these methods are used as stated in a recent study (Andrews et al., 2008, p. 50), “A limited or unrealistic expectation of the demands of a respiratory therapy program may be one of the largest contributors to attrition.” This is the case for orientation. In this program students are required to determine what they need to learn and then find their own information and teach it to another student, while being subjected to peer review, rigorous standards, and faculty who will often not answer questions. Such a learning environment could be a shocking experience. Purcell described the instructional process this way:

The students are given a scenario and they discuss the scenario and then they are to identify what they don’t know about it and what they need to know to be able to understand it better and then they are required to go on out and get information then they come back and present the info and they decide what’s important to tell the students. And then we encourage the students to give feedback to each other whether they are getting what they think they should get. And the faculty then has the very difficult role of sitting there and not telling them what’s right.

This is not a process that many students have previously experienced. McFarland says:

You know, our students come in with two years of college. You would expect juniors in college to have the ability to work independently and think through a problem . . . but their thought process is really low, and so you wonder, they were going through school where nobody ever challenged them.

If most students have not been previously challenged, the shock of this new approach could result in discouragement, frustration, and anger, which may not promote learning. Moore points out that the discouragement is usually temporary. “Once they get over it, and once they get over the frustration they come to like the process.” Moore told of a student who exemplified the need for orientation:
One of the guys got so mad at me. He was a big burly guy. When we interviewed him, he had already been up at 4:30 in the morning moving cows. Anyway, he was a bright guy and he was not used to getting told ‘no.’ One day I said to him, ‘I am sorry but you are wrong.’ He got all red and said ‘Well I don’t understand.’ I said, ‘Well, you can either ask me a question or you can go and read the material again. You have got to learn it. You have to get it right.’ There are those people who need a lot of orientation and resetting of expectations.

Because of the nature of the instructional practices, the faculty recognize the importance of an excellent orientation.

Students are told from the beginning of the application process that this program uses different educational strategies than they might be used to. They are warned that this will be the hardest program that they have ever been in (Glasser, 1998, p. 100), and that they will not be able to memorize information and then dump it. When the students enter the very first quarter of the program they are started in a PBL course that introduces them to the philosophy that follows in every course thereafter. Clark described the approach: “Rather than being handed the information, the students must read and discuss, so it sinks in better. You know when you have to kind of figure out a lot yourself.” Because this is the understanding of the program, when students ask an instructor a question, the instructors are likely to ask a question in reply, which the student will then have to answer. Moore says:

We force students to question one another. When someone questions you, they may get a little attitude, and you can’t escape them. So, if you get aggravated or frustrated by someone, work it out. So I start talking about that right away.

The students come to understand that the faculty are not trying to deprecate them, but that they fully believe that this intellectual work is required to prepare students to be who they want to be. In the words of Moore:

There is a camaraderie that the students develop with us, too. We are going to work them hard, we are going to test them and we are going to be hard and they are going
to earn every grade that they get because we care about them and we want them to be successful.

An orientation is thus invaluable when a program plans to initiate any rigorous educational practice. It is even more essential when the practice is out of a student’s prior experiences.

Faculty-to-Student Ratio

Faculty believe that for discussions to be effective, they must be the ones asking questions of the students, and this necessitates a good faculty-to-student ratio, where at times there is a low number of students interacting with each faculty member. Blevins said, “I see it in the clinical area. The nice thing is there I am sitting there one on one.” Effective student-to-student interaction and peer review do not happen on their own, and faculty are needed to solve the natural challenges that arise from these approaches. Yates said, “I make down-time, so I can teach. Including lunch is waiting for us or a snack or whatever we're bringing just to have that small group. One-on-one type contact . . ., I think, is a really strong element.” Advantageous faculty-to-student ratios are necessary as a means of supplying external motivation and appropriate structure.

A good student-faculty ratio is necessary to keep students adequately supervised in clinical. Purcell said we “are limited in the number of students we could take in our clinical facilities because we do keep them under arm.” Purcell describes how the clinical is adjusted to provide the appropriate amount of supervision to students:

You've got to give each student a little block here and a little block here and a little block there. And so we have to purposefully hold them back and only give them one or two patients per student.
Initially, students in clinical are said to need frequent blocks of time with the clinical instructor. Faculty do not see how a program could provide adequate instruction to students with only two full-time faculty members. Yates said:

To put a lot of attention to a small number of students, and so you need a lot of faculty to do that, because what you are doing is showing what integration is all about, and you cannot do that in a classroom with multiple choice tests. With, you know, 20 or 30 whatever the larger the number of students, the less one-on-one you give your students, and the more intimidated your students are to actually engage in conversation, and be critiqued and be quizzed, and it is a one-on-one type thing or small-group-type thing.

He added, to “teach people to be masters of something, you need a master in a small group or one-on-one.” The expert faculty in this program are adamant about having a small number of students in contact with faculty and in some cases even one-on-one instruction.

Faculty Perspectives on Curriculum

Purcell maintains that some topics are important enough for students to “get over and over and over again” rather than just once. Courses are sequential with knowledge building incrementally and always based on previous learning. Purcell says: “Every class we have is a prerequisite for every other class.” The curriculum is revised frequently. The program will keep working on the organization until it is satisfactory. According to Purcell, the faculty spend a lot of time in informal discussions, “We do sit down and try to figure out what our curriculum does; we spend a lot of time in informal discussion, picking each other’s brains.” Faculty retreats are scheduled for this purpose. Sometimes a faculty member will discover an important activity that would make a large difference in student learning, and that activity can then become a major part of the program. For instance, Walker was assisting a student in writing a paper for a scholarship. She received
no workload credit and the student received no credit for this activity. The faculty saw that this could be of benefit to all students, and the program curriculum was rearranged to give all students the opportunity to write a research paper. The curriculum includes deadlines to ensure that students turn work in on time. An online course alternates more difficult assignments with a chat assignment, in order to give the faculty an opportunity to catch up. The curriculum is arranged with external incentives so that students will participate at the appropriate level. A significant amount of time is allocated to clinical practice. Overall, curricular structure is purpose driven and dynamically modified in response to thoughtful and collaborative faculty assessments.

Quality Clinical Education

All faculty expressed the value of clinical education in the development of critical-thinking. Purcell said:

I think that that’s one place where critical thinking really can be because there’s never a clear answer in the clinic. You’ve always got this really general nonspecific problem and they need to collect the data, evaluate it, and come up with a plan.

The faculty had much to say about the way clinical education should be provided. Kennedy noted, “It is because I am actually in the clinic so I am able to see where they are actually being able to put the pieces together.” McFarland noted, “We take these things and move them into clinic, and that is one of the things that from my standpoint directly improves clinical care.” As a whole, the faculty felt that much of the clinical instruction provided across the nation could be improved. There was a worry that too much of the current clinical instruction provided by other programs is not beneficial, as students are often simply assigned to undermotivated clinical staff with no training in education, because these programs do not have the money to pay for clinical instruction.
Purcell said, “Because if you get a good clinical instructor he can make things come alive. If you get a bad one the students just get shut down.” In contrast to using unpaid and poorly trained clinical preceptors as is practiced in other programs, Purcell described the clinical program that they built:

But when you are talking about respiratory care procedures in the intensive care unit we want to make sure that the faculty that know what is going on in the classroom are also doing some stuff in the clinical, so that they know where to go with them, and what the level of development of the students is, and their job is to teach the students as opposed to performing patient care.

The optimal clinical program is what McFarland called “integrated instruction,” where classroom and laboratory instruction is studied and practiced prior to clinical practice. Prior to entry into clinical practice, students are given activities that develop abilities in research, thinking, and communication. The initial clinical supervision and instruction is then provided by the same instructors who have been working with the students in the laboratory and classroom. Moore said, “I think our faculty-led clinics are a huge part of our success.” This way, instructors know what the students have been exposed to and are aware of their strengths and weaknesses. Moore said, “I think one of the major benefits of having our faculty with the students in their initial clinics is that the clinical faculty are emphasizing assessment.” These instructors are able to ask questions in the clinical setting that help students associate what they observe with what they have already studied. Grover said, “I have the luxury of being both the clinical instructors and one of their teachers. I know what is going on in the academic areas as well as what’s going on in clinical.” The instructors are already acquainted with the students and are highly motivated to see them succeed. Faculty contrasted this picture with that of a student arriving at clinical and being assigned to a poorly motivated clinician who doesn’t
particularly want to teach and who has less than optimal demeanor toward the respiratory care discipline. Many of the seasoned faculty reiterated the importance of using didactic faculty for the initial instruction in the hospital. Quality clinical instruction builds critical thinking.

To ensure optimal clinical instruction, a preceptor training program has been developed, and only clinicians who have completed this instruction are allowed to supervise students. Student and preceptor clinical schedules are developed by the Director of Clinical Education. Paid clinical faculty may have as many as five students. The clinical faculty collaborates with the hospital charge personnel so that the patient load is appropriate to the level and number of students. The faculty member ensures that the students have adequate time to research and discuss appropriate questions. In harmony with the concept of situated cognition, it is this verbal questioning in the context of real clinical challenges that the faculty develops critical thinking. Verbal questioning with advantageous faculty-to-student ratios is the most important part. Yates rhetorically asks how these methods could not be effective:

I don’t think there is any chance of them not working. I guess that’s the reason, because they basically have to come up with, you know, ‘why’ and how things work. So how are they not going to work?

The value of student-faculty questioning is one of the reasons that the program makes arrangements to have didactic faculty also teach in the hospitals. This type of teaching would normally be expensive for the University, but it has developed an arrangement with local hospitals to provide contract patient care.

Under this arrangement the hospital pays the University for patient care and the University uses this pay to contract the clinical faculty. This allows the University to
cover the expense of instruction with a faculty-student ratio as low as four or five students per faculty member.

Preparing for Graduation

From the beginning, the program focuses on preparing students for graduation and their entrance into the clinical world. This is why students are taught to identify their own learning issues and why they are given practice in communicating, writing, and arguing for and against particular practice or points of view while maintaining rapport with colleagues. This is also why students are given practice in preparing for credentialing examinations, are required to conduct an asthma camp, and are provided with so much quality education.

Preparing for Credentialing Examinations

Faculty take the preparation for the national credentialing examinations very seriously. Kennedy sees examination preparation as connected to critical thinking and finds it interesting that respiratory care is a profession that actually “measures critical thinking on the examinations.” The program employs a different set of instructional methods designed to assure examination success. This set includes the “departmental comprehensive examination” (DCE). These examinations have questions modeled after actual multiple-choice credentialing examinations, and are part of a larger constellation of curricular components designed to assure credentialing success.

Purcell said that the program faculty study the exam matrix to make sure that each item is covered. “In the last three months we’ve been asking everybody to go through and identify what parts of the RRT matrix are . . . and we are identifying which classes these topics are covered in.” The program uses clinical simulations and has hired a faculty
member who is employed by Kettering National Seminars, an organization that offers nationwide review courses for examination preparation. Kennedy said, “We have faculty on board and she works for Kettering.” Students are tested on the material of the previous term in the subsequent semester, and then they take a DCE which is, according to Grover, “basically the big final exam for the entire semester.” According to Purcell, students are able to take credentialing-type examinations repeatedly online at home until they achieve the required score. “They have unlimited time to do it. They can take it 100 times.” The online examinations, which are not proctored, can be taken over an unlimited amount of time within a certain period. The student must pass the Written Registered Respiratory Therapist (WRRT) Self Assessment Examination (SAE) to graduate. Students are not required to pass the clinical simulation SAE examination because, according to Purcell, until they finish their clinical they really don’t know enough “to do a clinical simulation examination.”

The faculty use external rewards and sanctions to make sure that students master information at an appropriate time in the curriculum. According to Purcell, they don't allow the students to take the Certified Respiratory Therapist (CRT) examination halfway through clinical. “We aren’t playing that game. So it’s a carrot to get them moving along or sort of punch for a wayward child.” Students are not told what the answers are for the departmental comprehensive examinations, which they can retake. Instead, they are told to look up the information. The comprehensive examination questions are organized by categories that correlate with program classes. Kennedy said that “the test scores are good” and that these scores reflect the effectiveness of their learning and teaching strategies.
Program Assessment

The program faculty talk to students, graduates, and employers. Kennedy said, “The employers want our students.” The faculty members characterize program graduates as largely convinced of the effectiveness of program methods such as PBL. Beachy (2004, p. 96) reports that “consistent with the medical education literature, . . . graduates of PBL programs are generally more satisfied with their preparation than are traditional graduates.” The program has an excellent reputation across the country, as evidenced by the recommendations made by the committee on accreditation for respiratory care to consider this program for research. If student feedback on clinical rotations is poor, the program will stop using a clinical site. Purcell said, “Students come back and give us feedback on the rotations. . . . And they are usually pretty honest about it.” The faculty meet to evaluate the program and faculty performance is formally evaluated as well. These sessions are used to ponder how individual instructors can become more effective. Kennedy spoke about this extensively, “We meet, we analyze every year.” She said that the faculty are always asking, “How can I make it better.” The clinical area is improved the same way. Then faculty receive feedback from seniors prior to graduation. Kennedy gave an example:

We have changed the program based on student suggestions. In fact, we changed due to student concerns regarding gross anatomy. ‘Well you know this gross anatomy that we're taking. We really don’t understand why we need to know the butt muscles’ because the gross anatomy class does the whole body. And it was tough. And after a number of classes said this we re-evaluated this and asked, ‘Do we need them to do this whole body for gross anatomy?’ We think we can fix that to where they would be doing the cadaver for [primarily the] respiratory [system]. So we did that, and they [the students] have been much happier.

McFarland spoke of the faculty’s attitude toward improvement:
I think it was a natural migration from analyzing—if you are analyzing every semester every year what works, what doesn't work. First you have the focus that you want to go there, you have to adopt a philosophy that critical thinking is important. You have to adopt a philosophy that you want to make a mission, that you want to have mission objectives toward improving critical thinking.

The above are examples of how the faculty apply a “studied approach” to programmatic improvement. The program administrators systematically evaluate their experience, student evaluations, and program outcomes to adjust the curriculum and instructional methods. Unless those in charge pay attention to how learning is influenced by practice and how the curriculum works, the program cannot continue to improve.

Constant evaluation and re-evaluation has been recommended for the reform of allied health program accreditation (Baker, 2002, p. 93). Every semester, what works and what does not work must be analyzed. The mission of the program must be kept in focus. If the mission is critical thinking, one must be willing to follow the methodology that will achieve this, and to change if necessary. It is important to have people with different backgrounds who think differently. Administrative support is necessary. Through the experience of participating in program improvement the faculty have developed opinions about certain elements that make a strong program.

According to Grover, one way to strengthen programs is for the profession to require master’s degrees of its educators. She said:

I am for making it a real profession that requires professional standards, that requires this level of professionalism. But I say you hire the proper educators. You know just because you have been a therapist for 20 some years and they are too unstable to walk the halls anymore doesn’t necessarily mean that they should be teaching.

Yates also focused on aspects of faculty when reflecting on his 22 years of instruction. His thinking was that the most important elements of instruction include a low number of students to each faculty member in clinical and “rather than farming” students out to
unpaid and undermotivated clinical staff, programs should use paid and motivated faculty to provide clinical instruction. This importance of respiratory therapy faculty has been underscored in research that establishes a relationship between the degrees held by faculty and the learning outcomes of allied health students (Ari, 2005, p. 66; Jarvis, 2006, p. 1). Ari (2007, p. 43) also showed a correlation to respiratory care WRRT examination performance and the program budgets for faculty and the number of Ph.D. faculty.

Change, even at this institution, has not always been easy. It is important that program directors or other people trying to effect change do not prejudge the reasons as to why others are not immediately following. They may not be resisting change so much as they are fearful of it. Walker also felt that leaders should ask the opinion of others and be mindful of their concerns. Often, however, leaders will not receive an immediate answer. The environment for change must be one of trust.

The leader should model critical thinking while seeking to institute change so that all realize that there is no shame in not having all the answers. In a trusting environment, people will take responsibility for their own performance and mistakes, and will not blame them on others. According to Walker, leaders should take responsibility, and not blame those under them, when a program is trying to change and something does not work out so well. However, if something works well, leaders must make sure that they commend their followers for the excellent execution. These types of stances help to cultivate an atmosphere that is trusting and conducive to improvement. Attitude cannot make up for poor logic or poor planning, but it is a crucial part of the formula for improvement.
Additionally, Walker proposes that programs use technology to share expertise and complement each other. The faculty member of one program could teach a class for another program and exchange could result in overall improvement.

**Summary**

There are certain underlying concepts that influence the teaching strategies faculty choose and the methods whereby the strategies are employed. The themes reflected in the faculty beliefs are: (a) The program must motivate students to “learn by doing” and to be responsible in order for critical thinking to develop; (b) there are many effective learning strategies to engage students in the development of critical thinking; and (c) critical thinking is not learned unless essential program characteristics exist.

Faculty recognize that when students graduate they must be able to recognize problems, formulate theories, collect data, propose solutions, and implement them all without the benefit of the program and the faculty. If students are to learn to take these complex actions, they must “learn by doing” and be responsible for their learning. Purcell provides an example of a question he poses to his students, “What makes sense to you? Because eventually, you are going to graduate and I’m not going to be here and you need to learn how to make your own decisions.” Faculty also believe that motivation is at least as important to the development of critical-thinking as the intellectual or cognitive aspects of professional development.

Faculty believe motivation stems from—at the very least—an interest and fascination with the subject. Interesting learning activities bolster student motivation. There is a place for external motivation. Program requirements are organized so that students have to do things that are stressful and that they would not otherwise choose to
do, but, once done, they are appreciated. While students need to learn by doing, the role of faculty is crucial as a means of supplying motivation and structure. To prepare students to be independently competent, the faculty try to provide them with experience in solving the same kinds of problems. Students must learn to communicate effectively through experience and the best way to learn is to teach. Critical thinking is best learned in the place that it will be exercised. This is contextualized knowledge.

The faculty have adopted many strategies that require students to learn to communicate by interacting in authentic contexts. The program uses PBL, assignments, and clinical instruction that require the students to write, present, and argue for and against and frequently answer verbal questions, both in the classroom and laboratory, and in the clinical setting.

The faculty believe that certain elements of the program are essential to the students’ learning of critical-thinking. In order for verbal exchanges to be effective, the faculty must at times be the ones asking questions of the students, and this necessitates an advantageous faculty-to-student ratio. Student-to-student interaction and peer review do not happen on their own, and the faculty are needed to solve the challenges that arise from these instructional approaches.
CHAPTER 5

ALTERNATIVE REPRESENTATIONS

Introduction

The challenge for this research is how to conceptualize the findings of the expert faculty in a way that will extend our understanding of critical-thinking pedagogy. Is there a way to create an economy of representation that helps make sense of the complex? Information is inadequately appreciated when interrelated findings are placed into lists without any representation of how they work together or how to understand them. Is there any coherent beauty in what we discover? Metaphors can suggest how findings are holistically related and become fertile ground for new understandings that open doors to scientific research for years to come (Danforth, 2007, p. 10). A metaphor could help to explain how certain mechanisms work or do not work in certain contexts (Beachey, 2004, p. 113). “Metaphorical comparisons are those that appeal to the imagination as well as to the intellect” (Bartel, 1983, p. 45). The unpredictable comparison of a metaphor in this study is used for the same reason that the faculty studied attempted to be entertaining to their students. Reading research findings can be monotonous, but an instructive metaphor can provide some emotional relief in order to stimulate memory and stimulate further interest (Bartel, 1983, p. 46). The novelty and applicability of this metaphor may serve to assist with the dissemination of research findings.
This chapter presents two interrelated alternative representations: a metaphor and a mathematical model. Metaphors are prominent in language. Common metaphors that go unnoticed (Phillips & McQuarrie, 2007, p. 137) are internalized and have the ability to affect our conceptions of what we know. They have the ability to heighten aspects that are similar and mask areas that are not similar in the comparisons (Phillips & McQuarrie, 2007, p. 138). Metaphors are more than instructive comparisons. Because of the originality of the comparison they have the ability to move people to action. With this power there is a danger that metaphors are not understood or are misunderstood (Bartel, 1983, p. 33). Some metaphors found in common vernacular can negatively shape people’s interpretation of events. “Writers looking for ways to counteract complacency turn frequently to bold metaphors to stimulate both thought and feeling” (Bartel, 1983, p. 47). The inclusion of metaphor is intended to positively invigorate a discussion on the subjects of education and provide a provocative model.

The proposition of an algebraic formula as a way to represent interrelationships is commonplace and provides an economy of representation. This study’s findings are presented using the placenta as a bold metaphor. This metaphor elaborates upon the language use in social learning theory in which the zone of proximal development (Vygotsky, 1978, p. 86) is said to define those functions that have not yet matured but are in the process of maturating as currently “in an embryonic state.” Flowing out of the metaphor of the placenta is the idea that the relationships governing the diffusion of oxygen have similarities to relationships expressed as social learning theory (Bandura, 1977). Social learning theory provides an explanation for learning in terms of a “continuous interaction between cognitive, behavioural, and environmental determinants
Social learning theory provides inspiration for the models used to represent the findings of this study. This study uses the formula expressing the relationships governing the diffusion of oxygen to arrange the findings on motivation, learn by doing, and the engagement of faculty and other resources. This is done for the same reasons that the placental metaphor is applied. There are similar relationships within educational dynamics to those observed in Fick’s law and this similarity is likely to result in some pleasure and motivation for respiratory care instructors who typically love physiology. The formulaic proposal found later is given to stimulate discourse among respiratory care educators. The relationships expressed are educational constructs or postulates designed to invigorate instructive deliberation. This formula helps to demonstrate how the three major findings of this study are aligned within the social learning theoretical framework of Albert Bandura.

The Concepts to Be Modeled

The main beliefs of the expert faculty that need to be vividly impressed upon the mind are that students learn by doing and that learning is dependent upon motivation. Students must be made responsible for their own learning. Faculty use a variety of activities to enhance critical thinking, but in order for this to be done effectively certain programmatic principles must be in place. There must be a closeness or intimate proximity between the learner and faculty support, between the student and other resources such as labs, computer technology, and scholarly writings. The success of an educational program depends upon the interrelationship of many factors in a complex way similar to a living system (Kline, Kuklis, & Zmuda, 2004). A respectful metaphor
(Herbers, 2007, p. 105) can offer insights as to how these factors might relate to one another.

**Metaphor**

The dynamics which influence learning at the interface of the faculty and students are proposed to have corollaries with many physiologic characteristics found in the interface between mother and baby at the placenta. The mother grows a dense network of capillaries in preparation for the fetus, and the newly arrived fetus enters this capillary bed by growing a corresponding dense network of finger-like projections called villi, as shown in Figure 1.

![Diagram of secondary chorionic villi](http://en.wikipedia.org/wiki/Chorionic_villi)

Early on in the relationship a large surface area exists in the zone of diffusion for the transfer of life, giving oxygen, sugar, protein, carbohydrates, antibodies, and other nutrients from the mother. The fetus is also able to transfer back to the mother the products of fetal life, carbon dioxide, urea, etc. The mother’s blood absorbs these imperfections and keeps replacing them with the building blocks of life. The mother does not build the fetus; the fetus must do that. But the mother provides the building blocks and continually removes the broken pieces. There are multiple complex factors that influence the exchange of nutrient and waste products, including the large surface area, the narrowness of the placental barrier, and the magnitude of the concentration differences across the placenta (Reik et al., 2003, p. 5). When the mother’s blood has far more oxygen than the fetal blood there is a larger diffusion of oxygen than when there is hardly any difference at all. The placenta uses active transport in addition to diffusion to transfer nutrients (Reik et al., 2003, p. 6). What is necessary in the zone of proximal development for the flow of information and knowledge in a respiratory care program can be thought of as similar to the factors governing the nutrient and gas exchange that must be transferred from the mother’s bloodstream across the placental barrier and into the fetus.

In an academically strong program there is an immense amount of work on the part of the program faculty, administration, and staff in preparation for learning. Laboratory equipment, computer equipment, internet technology, the acquisition and training of faculty, the construction of detailed lesson plans, the adoption of progressive learning strategies for the hospital and the classroom, an integrated curricula as well as securing laboratory and classroom space are all part of the preparation needed for
effective learning. Likewise, in an academically strong program, matriculated students are oriented to understand the crucial role which they have in constructing knowledge and skill. The students learn that the faculty and laboratory resources are available and organized for them but they have to take advantage and use the faculty, students, and laboratory equipment. In the zone of proximal development the students have to attend and spend significant time closely interacting with other students and faculty and the assignments for learning to occur. The more difficult the skills and concepts to be mastered, and the larger the barrier to learning, the greater the amount of time that must be spent on the activities of learning and the greater the need for motivational support.

Program learning is dependent upon the student’s sense that what is to be learned is relevant to them and their future as respiratory therapists. This sense is accentuated when the student puts knowledge to practical use. When the student applies knowledge in the hospital, in the laboratory, or in the children’s asthma camp, she understands the value of that knowledge and desires more. The faculty’s passion for the knowledge to be learned and close questioning and interaction with the students while showing excitement and joy at the students learning also impresses the student with the importance of the information that is studied.

For a program to provide the necessary engagement and student discourse, it is imperative that the program have faculty of high quality in terms of graduate education, technical expertise, and passion (Ari et al., 2003). A program must also have sufficient laboratory equipment and space, clinical facilities, classroom computers, and library resources.
In this metaphor the placenta is the place of learning, the interface between the student and the many resources including faculty; the womb is the respiratory care program and the university is the mother. See Figure 2.

Under ideal conditions and in certain ways the mother is glad that there is one or more babies within her. The mother takes care of herself, because she cares about the baby. She feels like a very important part of her purpose at that time is to provide what is needed to grow the baby. The relationship of the university to students can be like that of a mother to her unborn child. However, it is possible for the university administration to have many different ambitions, including the initiation of new programs, obtaining grants, and publishing research. These are all important when the objective in part is to provide good education in the current programs. If, on the other hand, the students are largely viewed for the tuition they generate in order for that tuition to be used to serve these other goals, there is something amiss. There is nothing wrong with research, grants, or new buildings as long as these do not become the mission at the expense of learning in the classroom. Two different institutions can be doing the exact same things—securing grants, publishing research, and building—but one of these two institutions can have the right mission priorities which help education in the classroom, and the next institution can have the wrong mission emphasis, which results in less than optimal learning in the classroom. This means that it is a very important aspect of leadership to keep the mission straight. The baby that is valued must continue to be learning in the classroom, and learning in the classroom is not only dependent upon the faculty and students, it is also dependent upon the resources of the university.

**Mathematical Model**

One way to portray the results of this study and show their alignment with the theoretical framework is with a mathematical representation. The metaphor of the placenta, the fetus, and the womb begins to broaden the conceptualization of the zone of
proximal development and lay a foundation for a mathematical model (Beachey, 2004, pp. 101-104; Charmaz, 2005, p. 507). This metaphor proposes that there are elements that govern learning which may be arranged mathematically in a way that correlates with the physiologic variables governing diffusion of gases or solutes in the placenta according to Fick’s law of diffusion (Reik et al., 2003; Sibley et al., 2004). What follows is Fick’s law of diffusion:

\[
\text{Diffusion of Oxygen} = \frac{\text{Surface Area} \times \text{Gas Solubility} \times (\text{difference in O2 pressures P1-P2})}{\text{Barrier Thickness}}
\]

Here we see that the diffusion of oxygen is directly related to the surface area, the gas solubility, and the difference in partial pressures of oxygen across the placental membrane and inversely related to the thickness of this same placental membrane. A similar relationship may be demonstrated in Vygotsky’s and Bandura’s social learning theory:

\[
\text{Learning} = \frac{\text{Conspicuous Models} \times \text{Different Requirements} \times \text{Reinforcement}}{\text{Social and Economic Barriers}}
\]

1. *Highly conspicuous:* According to Bandura (1977, p. 54) “modeling serves as the principal mode of transmitting new forms of behavior.” Media provides symbolic modeling where the early adoption by influential leaders provides the most effective model. When attentive, people learn vicariously by watching and listening to those who act first (Bandura, 1977, pp. 39, 117; Rogers, 1995, pp. 52, 89). The intimate familiarity
with highly conspicuous models in this formula includes the social interactivity required in the zone of proximal development (Vygotsky, 1978, p. 86).

2. Reinforcement: “People who have been reinforced both directly and vicariously persevere longer in the face of nonreward than do those who have experienced direct reinforcement alone” (Bandura, 1977, p. 123). These kinds of reinforcement provide motivation.

3. Different requirements for adoption: Bandura (1977, p. 53) recognized that every idea has particular characteristics that influence the ease or difficulty of assimilation. To provide a comparable example from education we would say that learning to place a period at the end of a sentence would be different from learning to play the tuba. The premise for using strategies such as problem-based learning is that learning to think critically is more difficult than memorizing and recalling facts.

4. Social and economic barriers: Finally Bandura (1977) recognized the role that social and economic barriers may play in learning (p. 53). And so key variables that Bandura identified are easily arranged in a format similar to Fick’s law and conceptually they seem similar to the issues of surface area, pressure difference, solubility, and barrier thickness. This formula becomes instrumental in demonstrating how the findings of this research are aligned with the theoretical framework of social learning theory. A modification of terms is used to facilitate an understanding of this alignment.

\[
\text{Learning} = \frac{\text{Proximity} \times \text{Ease of Learning} \times \text{Motivation}}{\text{Learning Barriers}}
\]
1. **Proximity** in this study refers to a relationship between the student and human and symbolic models that determines the effectiveness of learning in the zone of proximal development, such as the close interaction with the faculty and student models, which is dependence upon the faculty-student ratio, peer-to-peer learning in the laboratory, or the time-to-faculty response in online education. This closeness conceptually seems to be similar to the need for surface area to enable gas exchange in the placenta and similar to the requirement that Bandura found that information and models must be highly conspicuous.

2. *Ease of learning* is the nature of the information to be learned just as each gas diffuses through the lungs at different rates depending upon its solubility and just as Bandura recognized that various ideas may be assimilated with more or less ease. This concept is here referred to as ease of learning. As an example, learning to think critically was considered by the faculty to be more difficult and would therefore have a low ease of learning, thus making more motivational support and intimacy necessary for learning to take place.

3. **Motivation** is similar to the difference in gas pressures which essentially pushes gases across the placental membrane. Where external motivation might be said to push for learning and we might think of internal motivation as the student’s pull to learn. These metaphorical differences in pressures are directly related to learning. Bandura described learning as directly affected by positive reinforcement and motivation. So the major finding of this study about the importance of motivation has a corollary place in the mathematical model.
4. Learning Barriers are illustrated by the placental barrier thickness and correspondence in social learning theory as “social and economic barriers.” Bandura’s terms are here conceptually expanded to include all learning barriers. These would include student disinterest, student learning disabilities, reading difficulties, instructor accent, and cultural barriers. The proposal then to respiratory care educators is to consider Fick’s law as a fun memory aid to help think about the corollary principles that will develop critical-thinking.

Summary

To deliver the data in a way that makes sense and connects with readers sufficiently to bear change is a question of writing and leadership. A bold development of the diffusion metaphor is used not only so readers will conceive how the results are interrelated with learning theory but also to emotionally grab them. This study issues two interrelated alternative representations: a metaphor and a mathematical model. One instructive aspect of the metaphor is found in the large surface area where the fetal villi grow into the rich capillary bed recently prepared by the mother. Here oxygen diffuses from a high concentration in the mother’s blood to a low concentration in the fetal blood in accordance with Fick’s law of diffusion.

Bandura and Vygotsky identified key dynamics involved in learning and these have been arranged in a mathematical model. The three thematic findings of this study align with two of the so-arranged social learning theory factors. This study proposes a modification of the social learning theory terms and a mathematical model. The formulaic representation of study findings and social leaning theory can serve as a useful vehicle for learning and discussing factors that influence the acquisition of critical-
thinking. It may appeal to respiratory care faculty because of its conceptual similarity to Fick’s law.
CHAPTER 6

SUMMARY AND CONCLUSIONS

Introduction

The complexity of respiratory care provides the background for this study. Respiratory therapists must be able to prioritize, anticipate, troubleshoot, negotiate, reflect, make decisions, and communicate with other health-care professionals (Mishoe, 2003, p. 500). The profession requires respiratory therapy education programs to prepare their students by developing competency in critical thinking (Kacmarek et al., 2009). For this study critical thinking is the “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990). Scholars (Mishoe & Welch, 2002) recommend using active strategies such as cooperative (Johnson et al., 1991; Van Horn, 2000) and problem-based learning (Ceconi et al., 2008; Mishoe, 1993) while tackling life-like complex problems in order to develop critical thinking. Working respiratory therapists must be able to move between different areas of the hospital and quickly develop rapport. If students learn information in classroom and laboratory settings that is dissimilar to those of the clinic they will be unable to use that information where it matters; they will not have developed the critical-thinking skills needed.

Select scholars have eloquently advocated and described methods such as
problem-based learning as a means of teaching critical thinking. The added insight from the front line faculty of a successful program on these issues has been missing.

No study has explored or described how a group of faculty, from their perspectives, organize the delivery of a respiratory care curriculum to develop critical thinking. Neither has any study considered broadly the strategies, techniques, and program characteristics that might contribute to improving critical thinking. And no case study has attempted to analyze the relationship between the practice of good respiratory care education and the related major veins of social learning theory. There really has not been a qualitative case study on critical-thinking education of this kind in respiratory care. Where previous research had carefully described the implementation of problem-base learning and program outcomes, a case study exploring the beliefs of faculty proficient in teaching critical thinking has been missing. A program director’s first-year experience with problem-based learning (Op’t Holt, 2000) and a subsequent quantitative study (Ceconi et al., 2008) of positive decision-making skills in the same program have been published.

This qualitative case study adds to the scholarship on developing critical thinking by adding the themes mined from nine audiotaped interviews of full-time faculty which were transcribed, coded, and considered in the light of classroom observations and program syllabi collected. The current study also adds a consideration of how good respiratory care practice corresponds to previous educational theory. This study provides a larger consideration of the educational techniques, strategies, and program components necessary to develop critical thinking rather than focusing on the implementation of problem-based learning alone. The current study broadens what a program should
consider when attempting to improve critical thinking. Publication of such case studies is essential so that the profession can develop a “nuanced” understanding of the realities of teaching critical thinking (Flyvbjerg, 2006, p. 223). This case study describes what those who are successful at developing critical thinkers in one program actually do and what they think. The purpose of this case study was to describe the beliefs and educational strategies currently used to develop critical thinking in an academically strong respiratory care program. Beachey (2004) advocated realistic qualitative studies that might help to explain under what circumstances strategies become effective (pp. 113, 114).

Because many of the active learning strategies recommended for the development of critical-thinking fall into the social learning class of strategies, this study uses social learning theory as a framework to consider the beliefs and strategies in respiratory therapy. The research questions are: What do expert faculty in a strong respiratory care program believe concerning the development of critical thinking? How are particular learning strategies consistently implemented by expert respiratory care educators to enhance critical-thinking and problem-solving skills in their students? Which program components best support the development of critical thinking? The chapter will begin by reviewing the theoretical framework followed by methodology, the results, a discussion, and conclusions.

**Theoretical Framework**

Social learning theory is a comprehensive theory (Bandura, 1977, p. 13) which attributes learning to the interplay between the individual’s thinking and actions and what they observe in the actions of others. In this theory one learns from the direct observation of others as models and from both verbal and written symbols (p. 13). Students also learn
by attempting tasks that just exceed their current independent ability to solve problems. In this zone of proximal development (Vygotsky, 1978, p. 86) the student collaborates with more capable peers under adult guidance. To accelerate learning, the source person or representation must be conspicuous and widely available (Bandura, 1977, pp. 50-55, 107-162). Advantages of this exchange with available peers and instructors are motivational factors because “many activities that enhance competencies are initially tiresome and uninteresting” (p. 104). After one acquires proficiency by first interacting with skilled peers and instructors, they become rewarding. Until then the peers and instructors help to generate motivation.

Aspects of motivation are central features of social learning theory. Motivation is dependent upon several factors including one’s own cognition. The ability of one to mentally represent future consequences is a source of motivation (p. 161). Bandura (1977, p. 162) identified goal proximity as another source of motivation. When a deadline approaches, people have a tendency to prioritize work and mobilize resources. Observing the success and failures of other people is an effective means of providing vicarious reinforcement and subsequent motivation (p. 117). Social learning theory does not regard extrinsic and intrinsic motivation as antithetical (pp. 104, 105). In addition to the exposure of individuals to knowledge and the reinforcements and motivation to learn, social learning theory also identifies the importance of barriers to learning and the unique qualities of the material to be learned as influencing the rate of acquisition. Perceived risks as well as social and economic factors are identified as barriers to learning (pp. 53, 54). The characteristic of the behavior or knowledge to be acquired is recognized as a factor influencing the rate of learning (p. 54).
Methods

A qualitative case study design was used to describe the beliefs and practices of expert respiratory care faculty on the development of critical thinking. The faculty were selected because they were employed by a strong program that was nominated by expert members of the Committee on Accreditation for Respiratory Care. Qualitative data were collected from classroom observation, audiotaped interviews of administrators and faculty, photographs of program laboratories, sketches, and program documents including syllabi, curricula maps, web-site material, and the student handbook.

Nine faculty were interviewed and audio-recorded. Interviews were transcribed, coded, and then mined for relevant themes using a cross comparative system. Interview transcriptions were returned to participants in the member-check process. Emerging themes were evaluated for correspondence with published research and theory and subsequently returned to senior expert faculty in a continued member check-process. Physiologic laws have been adapted to suggest educational relationships, and a physiologic metaphor was used to assist in understanding how relevant characteristics are interrelated and to suggest further understanding of the program components necessary to facilitate critical-thinking.

Results

The research questions for this case study were: What are the faculty beliefs concerning the development of critical thinking? How are learning strategies consistently implemented by expert respiratory care educators to enhance critical thinking/problem solving in their students? What program components support the development of critical-thinking?
Faculty Beliefs

The faculty beliefs centered on two primary concepts: the importance of faculty and students being highly motivated and that students learn by doing. Faculty who are excited about their work will exude this enthusiasm in their classes. Faculty enhance motivation by creating challenging learning assignments where the student’s own performance is a central topic of attention. First the students must work with their peers to identify questions, to research those questions, to bring answers forward, and then to present them. Then the students work together with their instructors to question, analyze, and contribute to improving that performance. This level of engagement creates a large emotional investment and increases motivation. Grading systems and points provide the motivation necessary to require the student to perform. As students see that they are gaining skill and knowledge, their motivation grows.

The participants in this case study emphasized the important role that faculty have in enhancing and supporting motivation not only by modeling passion themselves but also by expecting active participation leading to achievement. Bandura (1977, p. 104) reported that “it is not until after people acquire proficiency in” skills “that they become rewarding.” So until they are more intrinsically rewarding, the faculty help by modeling passion for the information and providing positive rewards in the course-grading structure. Faculty also motivate students to learn by tying classroom instruction to their clinical experiences so they understand the relevance. Students know the faculty are competent to keep them in line and this motivates students because they know they cannot slip by.
While the program faculty did speak positively about problem-based learning, they were unified in doing this while also equally emphasizing other educational methods and principles.

How Effective Strategies Are Consistently Implemented

The faculty work in a brand-new health science building with multiple, spacious, well-equipped laboratories and nine full-time highly educated and experienced faculty. The faculty are highly motivated and believe that their enthusiasm will help generate motivation in their students. The faculty organize challenging learning activities in which students interact with each other and with the faculty. This kind of cooperative work between students and faculty helps to support motivation.

Faculty recognize that students must practice the application of what they learn. They must learn by doing. Faculty use a number of techniques to provide support but they intend to not formulate or organize the problem for the student. Students are given opportunities to identify a problem, recommend a solution, and explain their own rationale. Just like in the clinical work after graduation, students must have practice working with other peers to solve problems. Faculty have to restrain their own tendency to formulate the questions and provide answers and instead give encouragement as the students do this work. Faculty organize learning sessions with faculty mentors for each small group, which is expensive but regarded as worthwhile. One objective is to stimulate academic controversy, that is, the students’ facts must be challenged. The objective is a give-and-take process among students and with faculty referred to as discourse. The rationale given is that they must learn to discourse with doctors. Program syllabi show that faculty require students to teach, present, and communicate. Faculty believe that the
best way to learn something is to teach it. Consequently, students make presentations to
other students and they organize and deliver instruction to children in asthma camp.
Students learn to evaluate and receive evaluations from each other through peer
evaluations. Students are required to do an honest peer review, as opposed to one that
glosses over the performance and reports that everything the student did was good. The
faculty want to get the students to talk and believe that requiring students to answer
questions will help them learn to think.

Faculty use problem-based learning as a major learning strategy for the
development of critical thinking. A good understanding of the techniques organized in
problem-based learning provides a conceptual framework and philosophy that informs
the faculty and finds expression in a variety of courses. In PBL, group members identify
learning issues and assign responsibilities for research to group members. Individuals
research the questions and come back to the group to make presentations on what they
learned. Group members question each other and rate each other’s contributions.

Within problem-based learning and in other learning activities faculty teach a
system for interpreting and supporting clinical recommendations. The names given for
these complementary systems are evidence-based practice and the whole-body approach.

In evidence-based practice the clinician recommends therapy based upon an
hierarchy of supportive research. The whole-body approach uses knowledge of
physiologic interactions within the body as the basis for recommendations.

Faculty consider reflection a major topic to bring up with students. Students are
given assignments that encourage reflection. Student writing as well as evaluations at the
end of a clinic is a reflective process. Faculty ask students to remember events that they were a part of, and then they are asked to verbalize what was learned.

Essential Program Components

Several program characteristics were identified as necessary to engage the development of critical-thinking in the students. There must be an adequate number of faculty and expedient faculty-to-student ratios at points in the program. At certain points in the program there might be four to five students to a faculty member in a class. Sometimes in clinical instruction there could be one student to one faculty member. The fact is that this program enjoys several new and well-equipped laboratories, good clerical assistance, a program library, and nine full-time faculty members. Three of these faculty hold Ph.D. degrees and a remaining five hold Master’s degrees with one member being labeled nonfaculty while holding a B.S. degree. These faculty believe that graduate education is required of faculty to create the environment for the best learning of critical-thinking skills.

Bandura (1970, p. 136) observed modeling behavior to be dependent upon vividness and novelty. This case study shows that faculty who are passionate provide vivid and novel instruction. To have passionate or motivated students you need to have passionate faculty. The faculty require a student to meet with a faculty member every time they receive a grade less than a B on a program examination. These findings correlate with the work of Ari (2007), which showed the connection between high faculty qualifications and program expenditures and excellent outcomes.

Every quarter this program uses a departmental comprehensive examination to ensure that students do not wait to review and retain previously learned material. In this
way, they assure what social learning theory (Bandura, 1977, p. 162) labels “Goal Proximity,” so that the students will not procrastinate to prepare for credentialing examinations. The faculty advocate program prerequisites and high admissions standards in a recognition that these characteristics influence the students’ capacity for learning. Such characteristics are called social barriers in the social learning theory (p. 54). These are the kinds of programmatic and curricular variables the participating faculty maintain are also necessary to overcome common barriers and ensure the successful acquisition of respiratory care skills.

Discussion

The understanding that comes from this study is that learning critical thinking in respiratory therapy does not happen by accident. Critical thinking is developed in a special learning environment that is consensually created. The student must be ready to learn and this is why motivation is important. Students are going to be less motivated to learn from boring and unmotivated faculty. This kind of environment has previously been described by social learning theorists as the zone of proximal development. This condition is one where students perform at a level only possible when they are working with faculty and students (models) who are more knowledgeable than they are. The students must spend significant amounts of time observing and thinking about these actual or symbolic models.

This study shows that social learning theory applies when one talks about teaching critical thinking to respiratory therapy students. Analysis of the faculty interviews in this study go on to confirm social learning theory by emphasizing the importance of faculty and other students as models from which students may learn.
Students must be given challenges that can only be met while collaborating with other students and faculty in the theoretical zone of proximal development, but there are other aspects which are essential to learning. These other aspects confirm the findings of researchers that the number of faculty and the academic qualifications of faculty are important. Beyond the faculty even more program characteristics are integral to the effective creation of the zone of proximal development. In other words, besides having excellent educational techniques and strategies such as problem-based learning, you have to have (a) great faculty, (b) students who are oriented, motivated, and thus ready to learn, (c) an organized curriculum, (d) quality clinical education, (e) preparation for graduation, and (f) on-going program assessment. These programmatic characteristics are equally important and do not arise out of thin air. Program resources flow from the larger institution that cares about the quality of education in the classroom.

Analysis of the faculty interviews in this study bring us to consider the connection between the prior work of social learning theorists and research that clearly demonstrates the importance of faculty and resources to programmatic outcomes. The faculty said that what creates critical thinking is not one strategy but that it is “all that we do.” There is much that is important to make the whole educational process function well.

Because this study says that educational techniques, strategies, motivation, learning by doing, and program characteristics are important, a tension develops about how to communicate the information and make it useful. In the inevitable rush to summarily characterize or classify research findings, much can be lost that is useful. Research findings may be minimized and subsequently discarded as inconsequential.
Despite this, for research to become known it needs a conceptual vehicle that holds the essential ideas, tantalizes, and uses an economy of time and space to communicate.

The metaphor of the zone of diffusion which occurs in the placenta and the intimate relationship between the mother and fetus around this area aptly represents the zone of proximal development without minimizing the complexity of all the interactions. The truth is that real education is complex, but this complexity can be understood and a metaphor can be used to convey the key relationships between the individual components. This is a good metaphor for respiratory therapists who love physiology.

The study’s findings can be thought of in relation to earlier scholarship. According to Beachey (2004), “A realistic evaluation . . . would begin by examining what activates particular learning mechanisms in particular contexts to produce desired outcomes, and would end by generating” knowledge “specific enough to inform changes in the program studied, and yet be transferable to the wider educational community” (p. 113). The major finding of this case study is that the message is “do not forget the basics.” There is not a single panacea but the answer lies in tending to many basic things consistently. The answer to developing critical thinking is that the engaging use of questioning and case-based instruction, discourse, simulations, and problem-based learning are effective when they have the right structure. And that structure includes beneficial faculty-student ratios, highly qualified and passionate faculty, and adequate classroom, laboratory, clinical, and curricular resources. Students who learn are those who are ready to learn are fully engaged and have a sort of scaffold created by the faculty and with the program resources. The important thing is not so much the question of whether the program is using problem-based learning or not, the factors that make a
difference have to do with the answers to the following questions: How does the program provide for student motivation? Does the program ensure that the student must learn by doing? Does the program have a scaffolding system to ensure that the student is fully engaged with program resources including faculty for significant periods of time? When problem-based learning is implemented in a way that ensures a positive answer to these questions, then critical-thinking is enhanced. And when other educational strategies such as writing and making presentations and debating are employed in a similarly rich way, critical thinking will also be enhanced. Critical thinking cannot develop as well in the clinical environment when there are not motivated and well-qualified preceptors who fully engage the student.

Whereas Beachey (2004, p. 113) said that a qualitative study would generate theories that could inform the wider educational community, this study offers a metaphor of placental gas exchange. The acquisition of critical-thinking skills in the zone of proximal development is governed by factors similar to those governing the diffusion of gases across the placenta. The metaphor helps to emphasize the importance of the study’s findings. In the placenta as in learning there are a number of factors that must be present. We know that the mother’s tissues and those of the fetus are extremely close over a wide surface area, and that pressure differences and both maternal and fetal involvement are essential to the transfer of gas. In a similar way we know that the close contact between the students and faculty, motivation support, and learning by doing are likewise critical in the zone of proximal development. And so this case study offers an interesting metaphor, a vivid picture to stimulate discussion, abstraction, extension, and memory. A mathematical model shows that the rate of learning is directly dependent upon a
motivation which creates a readiness to learn as described by Bandura and the close interaction or attention of the student to student and faculty models as described by both Bandura and Vygotsky. This is the zone of proximal development where there are student and faculty models which help the student perform at a higher level than they could otherwise. The model also shows that learning is dependent upon the support for motivation, the nature of what must be learned, and any learning barriers. This case study extends the conceptual framework of the zone of proximal development and social learning theory by showing its integration and dependency upon the program characteristics described in research. The model of the placenta and the mathematical model are used to facilitate the discussion of factors that are necessary to foster critical-thinking.

We should not be surprised that the findings of this case study are principles that have also been reported by educational scholars in other settings. Education in respiratory care is unique, but it still involves the challenge of transmitting skills and knowledge that are common to other professions and educational settings. The specific knowledge and skill to be transmitted is unique, which means that the findings of educational research are to be adapted but not disregarded as irrelevant. The impact of this case study will be clearly governed by the same principles of learning iterated by Bandura (1977, pp. 51-55) and this study. If this case study becomes highly conspicuous (p. 51) and is endorsed by prominent models, and if the metaphor is found to be of functional value, educators may use this study as a vehicle for the discussion of educational dynamics. This case study provides the type of context-dependent knowledge that contributes to true expertise (Flyvbjerg, 2006, p. 239). The impact of this study could be significant by providing an
interesting metaphor that will help educators concisely remember key variables that support the acquisition of critical-thinking skills. If it does, it has the potential to warn program faculty about trying to resolve resource problems with an educational strategy. It has the potential of helping programs and administrators to differentiate, or at least debate between what really counts among the infinite variables that influence education. Ultimately, such discussions have an enormous potential for improving education. Even if these metaphors and mathematical models only stimulate discussion and the ultimate adoption of other better models results, it still will have contributed to the discussion and interest.

The preceding discussion shows how this case study validates social learning theory, the zone of proximal development, and previous research. The faculty iterated the importance of motivation at several levels; they pressed the importance that students learn critical-thinking skills by doing. They did advocate the use of a number of important strategies and techniques that all serve to confirm social learning theory. They also advocated for faculty, program curricula, and support that have been shown in previous studies to correlate with program outcomes. This study also extends the theoretical framework by proposing a metaphor and mathematical model that show how the motivation and close work with student and faculty mentors integrate with other findings in research in a complex biological metaphor.

**Recommendations**

In the light of this study there are several recommendations that can be made for multiple stakeholders. The recommendations for each of these groups follow.
American Association for Respiratory Care

Recommendations to the American Association for Respiratory Care (AARC) are that it continue to offer the “Educator Academy” where faculty members can share their experiences in motivating students and implementing active learning strategies. The “Educator Academy” is also a venue for sharing knowledge on how to improve program characteristics.

Committee on Accreditation for Respiratory Care

The recommendations for the Committee on Accreditation for Respiratory Care (CoARC) are to consider a phased-in plan to require that new program directors and new directors of clinical education complete training in allied health education. It is recommended that the CoARC proscribe that faculty in programs having difficulty meeting accreditation thresholds, take university courses that are specific to motivation, learn by doing and program organization. The faculty in these struggling programs may suffer from isolation and are best exposed to the knowledge resident in successful programs. It is recommended that the CoARC continue with the requirement that programs having difficulty meeting credentialing examination thresholds complete progress reports tied to resource assessments.

Department Chairs

The recommendation for department chairs is that they provide well-equipped laboratories and access to professional training in education and to successful faculty in other programs. Then department chairs must hold the program director, the director of clinical education, and the faculty responsible to ensure strong program outcomes.
Program Directors

The recommendation for program directors is that they screen faculty applicants carefully for passion and insist upon high academic qualifications. Program directors must make sure that their faculty know how to plan for active learning. Program directors should review course syllabi to ensure organization and grading structures that focus attention appropriately. Adjunct or part-time faculty who do not display passion and ambition are not to be moved into full-time positions.

Directors of Clinical Education

The recommendation for the Directors of Clinical Education is to give particular attention to the quality of the instruction provided by preceptors or clinical instructors. Preceptors are to have training in how to provide the questioning and activities that tie didactic theory with practice. The student’s clinical records and evaluations focus attention and student motivation. Based upon the theoretical framework and study findings, it is imperative that professional communication is initially modeled by the clinical instructors in the clinical area. The clinical instructor must model communication with nursing, other allied health professionals, the respiratory care staff and supervisors, and with physicians. The job of modeling communication processes must not be left to tired, burnt out, and unpaid staff therapists. Clinical faculty are to have the flexibility to take some time away from patient care schedules to discuss clinical events and reflect on the implications. It is recommended that students are required to communicate with nurses and physicians and that they receive graded feedback on their communication.
Faculty

The recommendation for faculty is that they focus on planning. Active learning that results in critical-thinking does not come by accident. Those who execute problem-based learning or other active learning strategies successfully have well-organized, written plans. The course syllabus must be constructed to provide points for the activities. Well-executed learning activities are not easier than providing a lecture; they require more planning and close attention by faculty during implementation and in grading. The proper execution of activities that require peer review require the highest levels of faculty skill. If peer review is not planned carefully, students will not provide effective feedback. Faculty must learn to widen the repertoire of learning activities they use. Faculty should find avenues to share and learn practical knowledge from other faculty from other programs. Faculty must be able to professionally implement points and grades that will assure generalized classroom management and motivation. Didactic faculty are to study the effect between their own motivation and their grading structure and the motivation of the students. All faculty are to be or become experts in what they plan for students to learn and they are to become experts in what facilitates learning. To grow as a faculty member, one explores previously unfamiliar educational strategies. Expert faculty learn to construct a syllabus, lesson plans, and grading systems that require the students to fully engage the subject, to be able to find information, to present it, and to be open and positively engage those who see things differently. They construct a curriculum that rewards the development of communication skills. Students learn by doing, and what makes a respiratory therapist proficient in intervening to save lives has to do with collaboration. Programs need to provide students with practice in this area.
The findings of this research are that faculty can spread a wave of enthusiasm for learning respiratory care. Since motivation is the motor that helps us all to work and study, this aspect of education merits time in our professional discussions.

Students

The recommendation to students is that they fully participate in their learning. Students should realize that the faculty want them to succeed. Faculty work very hard to help students learn. When students learn, the program outcomes improve and the reputation of both the program and faculty increases. The future success of students and faculty are tied closely together. With this realization students should try to work to accomplish what the faculty have in mind. Respiratory therapy is fascinating and rewarding work. There are many challenging concepts and skills to master but these challenges can be both a source of interest and motivation.

Future Research

Future research is needed into how the community can assist a program in moving from one with inadequate faculty and program resources to a program with the generous resources needed. Since the profession, prior research, and this study advocate for faculty with graduate education, more studies are needed as to the development of graduate respiratory care programs. Since program faculty and resources have been shown to influence program outcomes, future qualitative narrative studies that tell the stories of how strong programs have developed the broad university influence necessary to secure resources are needed.

Many programs across the United States do not have nine full-time faculty members. They have two. Scholars should search these two full-time faculty programs
for one with excellent outcomes. Such programs should be studied qualitatively because these would help the majority of respiratory therapy programs identify how a program more like their own excels.

At EMSU critical thinking is developed by engaging students in learning by doing with peers, with motivated faculty, and liberal resources. Interaction with motivated peers and faculty is a demonstration of social learning theory in respiratory care education. This extension of social learning theory suggests that learning is directly related to the interaction and cooperation of the students to human and symbolic models, to the ease of the subject matter to be learned, to levels of motivation and indirectly related to learning barriers. Research is needed outside of respiratory care to see if the same relationships are observed there.

**Conclusions**

According to expert faculty, the elements necessary to successfully enhance critical-thinking strategies encompass student learning by doing and motivational and programmatic components. Faculty should not provide students with too much information because this robs them of learning to identify the information they need and of the skill in finding that information. Faculty must be passionate and know how to provide external motivators when students initially lack sufficient internal motivation. Any program that seeks to develop critical thinking must possess program characteristics including adequate faculty numbers and training. Curricular structure is needed that provides for optimal faculty-student contact and curricular organization requiring high levels of discourse. All of these findings can be illustrated in the metaphor of the placenta with the intimate contact provided by the large surface area at the interface between the
fetal villi and the mother’s blood. The pressure differences between the oxygen in the
mother’s blood and that of the fetus also determine the rate of diffusion. The relationship
of these factors is described by Fick’s law of diffusion, which suggests a similar
mathematical representation for the diffusion of critical-thinking skill to the respiratory
care student.
APPENDIX A

FACULTY/ADMINISTRATOR INTERVIEW PROTOCOL FOR QUALITATIVE STUDY
FACULTY/ADMINISTRATOR INTERVIEW PROTOCOL FOR QUALITATIVE
STUDY

Opening:

   Explain my background as respiratory therapist for 23 years
   Full time respiratory faculty member for 20 years as director of clinical education
   and program director.
   Doctoral student at dissertation phase
   Initiated a new bachelor of science degree program in respiratory care

Introductory questions:

   For how long have you been a faculty member or Administrator of a RC
   program?
   What attracted you to this college/university?

Transition question:

   What attracted you to respiratory care education?

Key question:

   How do your students learn respiratory care content? (This question is aimed at
   seeing how much content is learned in an experiential setting and how similar the
   setting is to practice (Czachowski, 1994; Hess, 1997; Op't Holt, 1994))
   What are the critical-thinking pedagogies used by your program?
   Probe: Please describe examples of activities you use in your program and
   how students have responded to them.
Probe: Why do you think these strategies work?

Probe: Describe ways you have adapted your instruction.

How did you come to adopt these [critical thinking] approaches?

How are your students prepared to take the clinical simulation examination? (The clinical simulation examination is recognized as measuring domain specific critical thinking. How does the program see itself preparing students for this examination? (Goodfellow, 1999))

Probe: Does your program facilitate reflection? If so how? (Reflection has been identified as an important component to the development of critical thinking)

Which methods would you recommend to other faculty as important for the day-to-day development of critical thinking?

Why do you believe these strategies work?

Probe: What are your beliefs about respiratory care education?

Probe: What are your beliefs about how people learn?

Probe: In my observations of instruction on your campus I noticed these instructional activities, what was the purpose of these activities?

Probe: How do you evaluate the individual learning activities that your program employs?

What would you recommend faculty do in order to become effective in organizing critical thinking learning activities?

How can a program that practices traditional methods of instruction transition to active methods?
Final Question:

Is there anything else you would like to tell me about how your program plans for the development of critical thinking.
APPENDIX B

QUALITATIVE CONSENT FORM
BELIEFS AND PRACTICES OF RESPIRATORY CARE FACULTY ON CRITICAL-THINKING STRATEGIES

James Hulse, Doctoral Student

I am a respiratory care practitioner by profession and have worked as a Director of Clinical Education for 13 years and as a Program Director for 7 years. I am conducting a research study about the organization of learning experiences to enhance critical-thinking and decision making.

In this study, I will qualitatively study one respiratory care program recognized as strong by members of the Committee on Accreditation for Respiratory Care (CoARC). I will travel to the institution to elicit expert knowledge on critical-thinking for the development of a survey. During the expert study I will code the responses of participants to preserve your anonymity. At no time will your name be used in the research study or in any subsequent publication of the research. Program artifacts will be collected including program curricula, lesson plans and other directions of individual activities of interest. The data will be kept secure during the research process and destroyed after the research has been approved. All information collected will be held in strictest confidence.

The data gathering process will involve an interview at a mutually agreeable time and location. The length of the interview is negotiable, duration of approximately one hour in duration would be valuable and will be tape recorded so that I can assure accuracy in reflecting your thoughts and perspectives as I analyze the data. During the interview I will ask you a series of questions pertaining to your involvement in educational activities. There are no “right” or “wrong” answers to the questions I will pose. I am seeking your perceptions.

Audio tapes will be transcribed by a person not affiliated with your college or university. I will provide you with the interview transcription and ask you whether it accurately reflects your perceptions. We can accomplish this review through e-mail and phone contact.

Your decision to participate or not to participate will not affect your standing at your college/university in any manner.

The entire data collection process will extend from September 1, 2005 to December 31, 2006. You are free to withdraw from the study at any time. If you have any questions concerning this project or the consent, please call James Hulse at (541) 245-7516 or Dr. Shirley Freed at (269) 471-6163

I, _________________________ hereby give my consent to participate in the research study described above. I have read and understand the statement and have had all my questions answered.

Date _________________________ Participant _________________________
REFERENCE LIST
REFERENCE LIST


VITA
VITAE

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BELIEFS AND PRACTICES OF EXPERT RESPIRATORY CARE FACULTY ON CRITICAL-THINKING LEARNING: A CASE STUDY

A dissertation presented in partial fulfillment of the requirements for the degree Doctor of Philosophy

by

James Leland Hulse

APPROVAL BY THE COMMITTEE:

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To all who inspire and
to Linda,
with love and gratitude
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CHAPTER 1

INTRODUCTION

Critical thinking is imperative for respiratory therapists who are responsible for making quick and crucial decisions regarding patient care under stressful conditions. They must use professional judgment not only to determine patient needs but also to communicate vital information to family and health-care colleagues. A respiratory therapist may be called to the bed of a patient whose breathing tube is completely blocked off. The therapist would not only need to identify the problem, but also communicate the rationale for removing the artificial airway. The three United States-based professional organizations charged with governance and direction of respiratory care produced the following tripartite statement: 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” (Traband, Hiser, & Gallo, 2003, p. 33). This statement demonstrates the importance that critical thinking is now being given within the respiratory care profession.

As the program director of a respiratory care program, I share the concern of my colleagues and professional organization that critical thinking is prioritized in respiratory care training. It is vital both at the patient’s bedside and in the setting of the national clinical simulation examination. To help the therapists develop these critical skills, respiratory therapy training programs and faculty must be preparing candidates to
do critical-thinking. This case study examines one university’s program that effectively uses strategies and faculty culture to help candidates develop these critical-thinking skills.

This chapter provides an introduction to the concept of critical thinking particularly as it relates to respiratory care education, and also provides an overview of my research on the beliefs of expert respiratory care faculty on the development of critical-thinking learning strategies.

**Background of the Problem**

While critical thinking is a construct many scholars have defined in various ways, Ennis (1996) provides a particularly relevant definition that fits well with the practice of respiratory care: “Critical thinking is a process, the goal of which is to make reasonable decisions about what to believe and what to do” (p. xvii). Respiratory care is a highly collaborative profession, practiced under the medical direction of physicians and in collaboration with nursing. Because of the nature of the job, the critical thoughts of respiratory therapists are most effective when they are developed and shared with other professionals. In respiratory care, practical elements of critical thinking include coherently voicing thoughts and carefully listening to others in order to find the best solutions to immediate problems (Mishoe, 1995).

While the collaborative aspect of critical thinking applies in other settings as well, these skills are particularly needed in respiratory care because of the migratory nature of the profession. In many jobs, individuals work with the same set of people every day and get to know them well, enabling them to create a strong team dynamic. Respiratory therapists work in a variety of settings, often with complete strangers. It is
not uncommon for a single respiratory therapist to work on the medical surgical floor, in the intensive care unit, the emergency room, the delivery room, and the nursery in a single day. The respiratory therapist with underdeveloped critical-thinking skills merely looks busy moving from unit to unit, performing tasks while not effecting needed changes in response to evolving patient dynamics. The respiratory therapist with well-developed critical-thinking skills is able to move into each area and quickly create rapport with clinicians, successfully co-managing patient care. The ability to move between groups of professionals while communicating patient evaluations and facilitating decisions to direct cardiopulmonary care is a particularly important element that critical-thinking helps to foster.

The realization of the importance of critical thinking in respiratory care is relatively recent. Historically, inhalation therapists and respiratory technician training emphasized the operation of equipment. Physicians gave the orders directing care, and respiratory therapists simply carried those orders out. Since the late 1980s, respiratory care practitioners have become increasingly responsible for crucial decisions determining the course of patient care. According to the American Society of Anesthesiologists (1996), Respiratory Care Practitioners (RCPs) “undergo unique and rigorous formalized training. The patients under their care frequently include a disproportionately sicker population than is the case for most other allied health practitioners” (p. 1).

Respiratory therapists deal with complex and life-threatening conditions. They must initiate, conduct, and modify care that includes the treatment of a tension pneumothorax, one of the most lethal of critical care emergencies. This is an acute
injury in which a tear or hole in the breathing tubes causes air to escape from the lungs, entering the chest cavity. During each attempted breath, more air enters this cavity and cannot escape, resulting in the buildup of high pressure. Tension on the heart and blood vessels prevent the circulation of blood through the chest and to the body. Patients tend to panic because they cannot breathe, and often fight or “buck” the ventilator (Tobin, 1991). If this continues for more than a few minutes, the result is certain death. To treat this condition, the respiratory therapist, along with the intensive care nurse or physician, needs to act quickly, determining the point at which needle decompression is necessary. The therapist must have the ability to retrieve information from his or her memory under stress in order to deal with these kinds of life-threatening situations.

Thinking critically requires information on which to base good decisions. Logic tells us that we must know important facts in order to determine the best life-saving interventions. Respiratory care graduates must, therefore, be able to retrieve vital information during a crisis in order to think critically. The failure to recall information in the context for which it should be applied is inert knowledge. Whitehead (as cited in Bransford & Vye, 1989) made the sobering claim that schools are especially good at producing inert knowledge as opposed to useful knowledge, and subsequent research has verified the existence of this problem. The reliance on lectures as a mode of instruction is partly responsible for producing inert knowledge. Still, many respiratory care educators have not made the transition away from lecture-based instruction (Hopper, 2002; Mishoe, 1993; Op't Holt, 1994). Those who try more student-centered techniques are often met with resistance or conflict (Lenburg, 1999, p. 11; Mishoe,
from the students, who initially struggle to adapt to the kind of active learning that promotes critical thinking.

In the context of respiratory therapy, inert knowledge can be devastating. A respiratory therapist unable to remember the steps necessary in the management of sudden distress in a ventilator-supported patient may respond inappropriately, delaying definitive care. Such a delay could result in death or profound brain damage.

The respiratory care profession recognizes the importance of the educational community and faculty as a resource supporting the development of critical thinking. This is illustrated in the following portions of the tripartite statement by the professional respiratory organizations: “We strongly support faculty development activities specific to educational methodology. We support the development of baccalaureate and graduate education in respiratory care and encourage respiratory therapists to pursue advanced levels of education” (Traband et al., 2003, p. 33). If respiratory care is going to produce therapists able to function appropriately, its faculty must be knowledgeable regarding the means to this end. Clinical and technical proficiencies alone are inadequate qualifications for respiratory care faculty. Faculty must know what is needed to develop critical thinking. Hill (2002) highlights this need, recommending that further research be conducted in order to improve the foundations of evidence available to guide educators in developing critical thinking and decision-making skills in respiratory care students. More recently, Beachy (2004, p. 114) recommended the development of an outline of the optimal conditions under which each educational mechanism operates most effectively. A comprehensive description of the optimal educational conditions needed to develop critical thinking remains a research challenge within respiratory care.
The adoption of critical-thinking-based approaches represents a difficult shift for both faculty and students. Students experience a great deal of tension when they transition from a passive approach of learning to problem-based learning (DeMarco, Hayward, & Lynch, 2002, p. 167), which is key to developing critical-thinking skills. Students accustomed to writing notes and memorizing facts to pass examinations will find differentiating between the plausibility of arguments a challenge for which they are unprepared. Likewise, faculty find a significant challenge when moving from teaching and testing right and wrong answers to teaching and testing thinking processes.

**Statement of the Problem**

The development of critical-thinking skills during the professional training of respiratory therapists is imperative for good practice. Research evidence suggests that interactive instructional strategies are far more effective than traditional lectures. Missing from the literature are thick descriptions of how faculty organize the delivery of respiratory therapy curriculum to develop critical thinking. The focus of this study is the development of critical thinking in respiratory care training.

**Purpose of the Study**

The purpose of this case study was to describe the beliefs and educational strategies currently used to develop critical thinking in an academically strong respiratory care program.

**Research Questions**

What do expert faculty in a strong respiratory care training program believe concerning the development of critical thinking? How are particular learning strategies
consistently implemented by expert respiratory care educators to enhance critical-

thinking and problem-solving skills in their students? Which program components best

support the development of critical thinking?

Methodology

I used a qualitative, single case study design to identify critical-thinking

strategies incorporated by the faculty into a strong program. The program was

nominated by expert members of the Committee on Accreditation for Respiratory Care.

Qualitative data were collected from classroom observation, program documents, and

audiotaped interviews with administrators, faculty, and students. These data were

analyzed and represented in a metaphor and a mathematical model.

Theoretical Framework

This case study is viewed from the perspective of social learning theory,

established by Albert Bandura (1977). As with other adult learners, respiratory care

students are expected to influence their own thinking, as well as that of others, through

social learning. According to Bandura, learning is a function of the individual

interacting within an environment. In the environment students are said to learn

vicariously by observing the actions of others (Bandura, 1970, p. 167; Merriam &

Caffarella, 1999, p. 258). Bandura’s research (1970, p. 123) demonstrated that less

learning occurs simply from observing modeled behavior. More learning occurs from

modeled behavior when motivational variables are present and when there has been

prior training in discrimination and the anticipation of positive and negative

reinforcement.
In harmony with social learning theory, Freire (2005, p. 92) recognized that learning takes place in a social network, and that social dialogue is particularly important in “generating critical thinking.” And according to Vygotsky (1978, p. 90), learning occurs only through interaction with people and in cooperation with peers. Learning to think critically in some activities may be tiresome and uninteresting until the individual develops proficiency. Social learning theory (Bandura, 1977, p. 104) stipulates that in these areas social reinforcement is important in encouraging the participation necessary to develop proficiency. Respiratory care students benefit from activities in which they learn as a group, both to help them through the monotonous activities required for proficiency, and for learning how to behave in critical care situations. Learning with peers also allows them to perform at a higher level than they could alone. When students perform at a higher level with others they are said to be learning in the zone of proximal development (Vygotsky, 1978, p. 87). This interaction prepares them to successfully navigate highly interactive roles after graduation.

Bandura (1970) reported the increased adoption of modeled behavior when children watched attentively and verbalized responses (p. 134) and when the models were vivid and novel (p. 136). This kind of social observation and learning may occur in academic discourse. When students observe classmates and faculty learning and finding success through a process in which they eagerly and openly explore ideas, they too will adopt similar behaviors. Discourse is a conscientious effort to “validate contested beliefs and understandings” (Mezirow, 1999, p. 2) and this validation becomes the anticipated outcome (Bandura, 1970, p. 132) that results in the subsequent matching behaviors. In discourse, differences in knowledge and understanding are valued because their
exploration is seen as a means of improving the thinking of each participant. Negotiating exactly this kind of communication is what respiratory therapists need to do successfully.

Because respiratory therapists think and work in a milieu of interactions with patients, family members, and other caregivers, it seems reasonable to suggest that educational strategies that include social interactions would be most effective in the developing of the kind of critical thinking that respiratory care students will eventually use in the workplace.

**Significance of the Study**

This case study offers specific ideas for respiratory care faculty, staff, and students as to how critical-thinking learning strategies are implemented in an academically strong program. The beliefs of expert faculty can be compared to one’s owns practice and belief. The reader can lift these views up and view them from their own perspectives. This process offers a potential to find or emphasize important keys to effective teaching. This case study describes the ideas of expert faculty about what is needed to make critical-thinking strategies effective. The examination of these ideas can provide an interesting method for faculty to use in developing and evolving their own thinking. This case study may also be useful for review by graduate students who are likely to be future respiratory care educators.

Students will benefit from this study as recipients of the practice of their instructors. When faculty gain knowledge and experiences in fostering critical thinking, students will enjoy better education. Practical strategies recommended for the development of critical thinking contain several elements supporting student motivation.
Such strategies may be organized in a way that provides what Brophy (1998) terms *relative autonomy*. Critical-thinking strategies may be employed in ways that provide optimal challenges and allow active involvement. Workers and students need activities that provide skill variety, task identity, task significance, and collaboration with peers (Brophy, 1998). More of these kinds of activities may be implemented as a result of this study. In addition to the improved development of thinking skills, students should experience greater satisfaction and motivation with the learning experience even though the initial shift may have been difficult.

Ultimately, this research may impact overall patient care. The reasons for our research and our educational practices must transcend the need for increased learning and motivation of faculty and students. An immeasurable objective, but nevertheless a mission of this research, is a reduction in the morbidity and mortality of the patients whom students and, ultimately, graduates serve.

**Assumptions**

My study assumes that essential and substantive information regarding how expert educators organize learning to develop critical thinking can be collected from a single program through one qualitative case study. It further assumes that recognized experts at a strong program in respiratory care education organize learning at a superior level, making them worthy of study.

**Delimitations**

This qualitative case study was delimited to one program nominated by respiratory care education and accreditation experts and members of the Committee on Accreditation for Respiratory Care.
Limitations

The qualitative case study is limited by the number of administration, faculty and students present during the on-campus visit. The qualitative case study is further limited by the number of classes that can be observed during the available time.

Definitions of Terms

*Critical thinking* (CT) is the “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990). As applied in respiratory care, critical thinking includes communicating and negotiating (Mishoe & Welch, 2002, p. 44). It also includes the ability of the clinician to help a group of professionals come to the safest and best patient care decisions.

*Problem solving* refers to the cognitive processes involved in achieving a goal, especially when the best way to achieve this goal is not immediately obvious (Wilson, Fernandez, & Hadaway, 1993, p. 1). In respiratory care practice this would include interpreting data after initiating a change. It would involve communicating one’s evaluation of whether the problem is closer to being solved as a result of the imposed change and then communicating the implementation of a subsequent change in response to new understandings.

*Decision making* is the cognitive processes used in judging, evaluating, choosing, selecting, picking, and resolving. In most cases of problem solving, some decision-making processes occur. However, problem solving involves generative processes whereas in decision making there are known alternatives (Butler, 2003) that
one must decide between. In respiratory care, decision making is usually done in consultation with other professionals.

_Inert knowledge_ is knowledge that is not used by the individual in a place of logical application (Bransford & Vye, 1989, p. 188, Eisner, 1994, p. 205). A respiratory care student may learn about the laws governing artificial airways in the classroom but be unable to apply these laws in a clinical situation at the hospital.

_Educational technique_ for the purpose of this study is a single teaching method thought to enhance learning. Calling on students in class is an example of a technique used to keep the student focused and interacting with the subject of the class.

_Educational strategy_ is a “pattern of instructional effort” (Koepke, 1993, p. 11; Weissman, 1990) which consists of the arrangement of a number of teaching techniques. This recipe is thought to be synergistic when correctly implemented.

**Summary**

The development of critical thinkers in respiratory care is essential to quality health care. Strategies used to enhance critical-thinking are widespread, but practical insight into their successful implementation by expert faculty in respiratory care has been insufficiently described. This qualitative case study provides a description of the beliefs that faculty hold about critical-thinking and the ingredients these recognized experts consider important when implementing critical-thinking strategies.

Chapter 2 provides a review of literature about critical thinking in general and specifically in respiratory care. It also presents an overview of social learning theory as a framework for understanding the development of critical thinking in respiratory care. Chapter 3 contains a description of the methods used in this case study. Chapter 4
describes the data on the faculty’s beliefs and practices collected qualitatively at an expert respiratory care program. Chapter 5 proposes a metaphor and mathematical model to suggest how the program components and educational approaches necessary for the development of critical thinking are interrelated. Chapter 6 provides the discussion, recommendations and conclusions.
CHAPTER 2

LITERATURE ON CRITICAL THINKING

Introduction

This chapter reviews the timeless nature of critical-thinking concerns, the critical-thinking construct, and the teaching strategies used to develop critical-thinking and respiratory care research related to critical thinking. Finally, the chapter offers aspects of social learning theory as a framework for understanding additional ingredients necessary for the development of critical thinking in respiratory care.

The Timeless Nature of Critical Thinking

A unique quality of human nature is that people are “constantly re-creating and transforming” (Freire, 2005, p. 99). Human creativity and intelligence are essential to our survival as social beings, since we lack the physical characteristics of claws, fur, feathers, and sharp teeth, as well as many instincts that help other species to survive. It is our ability to amass information, to model the abstract constructs of cause and effect in our minds, and to subsequently build what we imagined that has resulted in the technology that gives us an advantage in our environment and provides for our survival. It is the ability to use and communicate thought that allows our basic survival as well as the survival of our collaborative efforts. Our social institutions survive and compete through collective thought and superiority in communication. Essentially, both our individual
survival and the survival of our social institutions are dependent upon the care of our thinking and communication. This has been recognized for millennia and forms the basis for the perennial interest in education.

**Solomon**

The earliest records that we have of people recording advice about how to think and teach were from religious people who believed in one or more gods. Their writings were handed down, are currently studied, and have millions of followers today. King Solomon is an example of a wise man who wrote in 967 B.C.E. and whose writings have devotees in Christian, Jewish, and Islamic traditions today. Solomon recommended a proper attitude as a means of developing wisdom (Schoenberg, 2003). To be “wise” or to “have understanding” is the English translation of ancient terms whose definitions seem to overlap with what we are calling “critical thinking.” Solomon emphasized that the primary responsibility of the learner was to be enthusiastic in the pursuit of wisdom.

Solomon recorded his prescription:

> Turning your ear to wisdom and applying your heart to understanding, and if you call out for insight and cry aloud for understanding, and if you look for it as for silver and search for it as for hidden treasure, then you will understand. . . . For wisdom will enter your heart. (Prov 2:2-5, 10 NIV)

Solomon is famous for finding unusual solutions to problems. The example in the Bible of Solomon’s wisdom is provided by his judicial testing. In the story, two harlots come to him both claiming to be the mother of an infant. When, however, Solomon gives the order to “divide the living child in two, and give half to the one and half to the other” the true mother cries: “Oh, my Lord, give her the living child, and by no means kill him.” But the second said, “He shall be neither mine nor yours; divide him!” Then the king answered and said, “Give the first woman the living child, and by no means kill him. She
is his mother” (1 Kgs 3:16-28). This example of the ability to dialogue in order to test other people’s positions with the purpose of establishing the most sensible course of action is a sound illustration of the kind of critical-thinking that this case study is about.

Socrates

Plato’s (427-347 B.C.) dialogues provide a record of what is known as the Socratic method (Stevenson & Haberman, 1998). Plato records the words of Socrates to depict the interaction between the master and the student. Described as the dialectic (Plato, 1937a/300 B.C.), the tutor provides a system through which the assumptions and framework whereupon the student thinks can be examined. In this examination, Socrates is portrayed as bringing forth the new idea as a midwife brings forth a baby.

The triumph of my art is in examining whether the thought which the mind of the young man is bringing to birth is a false idol or a noble and true creation. . . . Some of those who converse with me, at first appear to be absolutely dull, yet afterwards, as our acquaintance ripens, if the god is gracious to them, they all of them make astonishing progress; and this not only in their own opinion but in that of others. (Plato, 1937b/300 B.C.)

Socrates’ art is focused on creating true and noble thinking in the student. This art, which can result in astonishing progress, is the art of creating the dialectic. It is an exchange in which the basis for the student’s beliefs is patiently questioned and discussed, bringing the student to a greater understanding of her own perspective. The teacher may take the position of an opponent while questioning the student. This questioning leads the student to view and develop a nuanced understanding that would otherwise be unlikely.
Francis Bacon

Francis Bacon (1561-1626) wrote one of the first books (Bacon, 1952) on critical thinking. Bacon identified the first problem of learning as a preoccupation with reading books and insufficient investigation of matter itself (p. 12). He felt that the human mind was prone to believe whatever came most naturally. Beliefs that had not been subjected to careful investigation but resulted from prejudices or passion were called “idols” (p. 111). Bacon advocated pedantic knowledge acquisition that included the wise selection and timing of what should be taught, the progression from easier to more difficult topics, the allocation of topics specific to the “wits” of the students, and the effort to ensure that students not “exercise their faults” (p. 69) and therefore practice or develop bad habits.

René Descartes

After completing the full curriculum of languages, letters, logic, ethics, mathematics, physics, and metaphysics at the Jesuit School at La Fleche, Descartes (1596-1650) declared, “I found myself embarrassed with so many doubts and errors” (1952, p. ix). Years later Descartes proposed 21 rules for coming to knowledge by breaking down questions into simple elements which were then studied and represented in math-like expressions and geometric shapes. Descartes felt liberated by the logic of mathematics and modeled his method upon the pure means through which the “earliest pioneers of philosophy in bygone ages” established philosophy upon a “species of mathematics” (p. 6). He was also concerned enough about imagination and memory that he encapsulated the visual display of ideas in rule XV (Descartes, 1952, p. 33) for this purpose. The method described in Descarte’s rules appears to have helped to lay the foundation for the careful systematic methods used in scientific investigation today.
John Dewey

John Dewey (1859-1952), a pragmatic philosopher, illustrates the modern interest in the development of thinking. To Dewey (1939) thinking was not a mental process separate from the employment of objects, activity, or work. Dewey did not advocate thinking for the sake of thinking and he viewed the employment of thought to accomplish a tangible goal as an important motivating element.

To Dewey, two characteristics of successful teachers are that they study and understand their individual students and they understand the total atmosphere of learning. For example, Dewey (1939) writes, “The more a teacher is aware of the past experiences of students, of their hopes, desires, chief interests, the better will he understand the forces at work that need to be directed and utilized for the formation of reflective habits” (p. 615). To improve the process of “mere thinking” Dewey (1939, p. 843) recommends a reflective process that “involves running over various ideas, sorting them out, comparing one with another, trying to get one which will unite in itself the strength of two, searching for new points of view, developing new suggestions; guessing, suggesting, selecting, and rejecting.”

Both Solomon and Socrates are examples of the ancient concern for thinking among leaders who helped to establish conceptual frameworks and traditions that have lasted like the pyramids of Egypt until the present day. More recently Francis Bacon, Rene Descartes, and John Dewey emphasized a careful attitude, a systematic approach, and a connection between empiricism and scholarship as a means of developing thinking skills.
**Critical-Thinking Construct**

The critical-thinking construct is important to examine. The American Philosophical Association Delphi definition of critical thinking is the purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. . . . The ideal critical thinker is . . . prudent in making judgments, . . . orderly in complex matters, diligent in seeking relevant information. (Facione, 1990, p. 2)

This definition provides an expanded picture of what scholars mean when they use the term critical thinking. It is consistent with the definition provided by Ennis (1985, p. 45): “Critical thinking is reasonable, reflective thinking focused on what to believe or do.” However the Ennis definition emphasizes the need for critical thinking to involve a practical application. This is in line with the pragmatism of John Dewey. Critical thinking in the respiratory care context includes a specific interest in its practical applications in the clinical and academic context (Mishoe, 2003).

According to nursing scholar Duldt (1997), accreditation expectations require nursing faculty to develop their own definitions of critical thinking. Duldt recommends the above cited Delphi definition for consideration in this process. This recommendation lends credence to the generally recognized authority of the Delphi definition.

Respiratory care scholar Mishoe (1993) reported that the term “critical-thinking” had “become an omnipresent buzzword in educational writings” (p. 31). She proposed 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). Her research responded to the need to describe critical-thinking in a clinical setting rather than the campus of a college or university (Mishoe, 2003, p. 501). Her
earlier recommendations had been to look at the characteristics of a critical thinker (Mishoe, 1993, p. 32). Paul and Elder (2002) call these characteristics the traits of the disciplined mind, or intellectual virtues (p. 19). Mishoe’s (2003) research has identified the abilities that are demonstrated when respiratory therapy clinicians use critical thinking in clinical practice. These include the abilities to prioritize, anticipate, troubleshoot, communicate, negotiate, reflect, and make decisions (Mishoe, 2003, p. 500). Respiratory therapy scholars are concerned with these abilities whenever they speak or write about critical thinking.

Clinical critical thinking includes a constellation of contextual abilities, including communication skills, enabling one to individually and collectively solve problems, make decisions, and coordinate with others. The practice of health care involves the interactive and collective decision making of individuals from a variety of backgrounds. The decision of any single individual may be of little value if it is not made in conjunction with the patient and other clinical decision makers. The nurse, therapist, or patient may have a solution to a healthcare dilemma, but if that solution is not shared, with the relevance and weighted advantages adequately communicated, the solution may fail to be implemented. Repeated failures of this kind will be a source of frustration that may extinguish future communication attempts and lead to a less effective clinical team. Therefore, critical thinking is of no value in a clinical environment if it does not include effective communication.

**Educational Strategies for Critical Thinking**

Interest in critical-thinking learning strategies increased in the mid to late 1980s. During this time researchers identified successful instructional methods in critical
thinking. This section deals with the goals of critical-thinking strategies and examines two exemplary strategy examples: cooperative learning and problem-based learning.

The Goals of Critical-Thinking Strategies

Critical-thinking strategies aim to move students from passive learning to active involvement in the learning process (DeMarco et al., 2002, p. 165; Mishoe & Welch, 2002, p. 4). Students must practice self-regulation (K. J. Wood, 1998, p. 5). They are encouraged to reflect upon and identify their own critical-thinking processes (Greene, 2000, p. vi). This is a practice which will continue to enhance the proficiency of clinicians after graduation. As such, the student must be given practice in the autonomous interaction with others that will be required in the clinical context. Continuous rigid structure and inflexibility or a lack of interaction with others will prepare students to function merely as machines, unable to provide the necessary creative and abstract applications to real-life problems.

In contrast with traditional teaching, critical-thinking strategies do not “perpetuate the idea that there is only ONE correct answer and that the teacher is the expert who has all the answers” (Mishoe & Welch, 2002, p. 4). Critical-thinking strategies encourage interactive discussion of complex and controversial topics (Mishoe & Welch, 2002, p. 4). The instructor’s “task is to listen for what the group voice is saying and to play that voice back from time to time so the group can hear and even change its own collective mind” (Palmer, 1998, p. 76). This does not mean that the instructor never provides information. The approach used, however, does not assert finality or perfection, so the student is free to accept or reject the instructor’s information or point of view. The student is led to rationally analyze the basis upon which assertions are made, in order to accept or reject
any authoritative source. *Understanding by design* is said to occur as a result of cycles of questions and answers (Wiggins & McTighe, 1998). Such questions and answers are expected of all members of the learning circle as the means whereby one determines what to believe or do.

Successful critical-thinking learning strategies encourage active self-regulated learning, emphasize thinking processes over content, encourage interactive discussions, are domain specific, and concern themselves with complex, loosely defined problems that have multiple solutions. Faculty efforts are most successful when they focus their efforts on developing students’ competencies and talents (Johnson, Johnson, & Smith, 1991). These approaches contrast with the highly organized lecture approach (Hart, 1983). While this approach has the advantage of presenting large quantities of information in a logical way, the downside is the lack of student participation, which is key to developing good critical-thinking skills.

Critical-thinking pedagogies include *domain-specific* instruction, which is teaching occurring specifically within the practice of the profession (Ironside, 2003, p. 510; Mishoe & Welch, 2002, p. 514). Domain-specific instruction involves context-dependent problems, requiring a realistic, non-classroom-based setting (DeMarco et al., 2002, p. 165; Oermann, Truesdell, & Ziolkowski, 2000, p. 1). For example, respiratory therapists are likely to face many instances where they need to decide whether to increase or decrease oxygen flow to a patient. As students, they should be presented with these situations in a realistic environment, such as in a lab with a simulated patient. This will provide more assurance that the knowledge will not become inert, that is, only remembered in contexts that do not matter. Dewey might assert that thinking does not
occur at all outside an experiential context (Dewey, 1939). Thorndike (Vygotsky, 1978, pp. 82, 83) rejects the idea that learning in a formal discipline such as classical languages and mathematics results in a generalized ability that can be used in another dissimilar subject. Domain-specific learning should therefore include the specific settings and realistic problems of the profession that require critical thinking.

Two Exemplary Strategies

Two critical-thinking learning strategies are described as exemplary: *Cooperative learning* because it has a long and extensive research base (Ellis & Foutes, 1993) and *Problem-based learning*, because of its broad and strong advocacy among educators of physicians, nurses, allied health professionals, clinical psychologists, occupational therapists, physical therapists, and physician assistant programs (Mishoe, 1993, p. 33). Problem-based learning has also been strongly encouraged by respiratory care scholars (Mishoe & Welch, 2002; Op't Holt, 1994, 2000). Cooperative learning provides other social learning activities (Johnson et al., 1991). These structures are described in the following sections.

**Cooperative Learning**

Cooperative learning is highly structured and focused on the task of learning. The cooperative process is considered to be supportive of the needs of students for productive relationships while it includes a kind of intellectual work that is different from lower order memorization (p. 12). For example, in respiratory therapy (Mishoe & Welch, 2002, p. 44) this different kind of intellectual work could include negotiation or shared thinking.
Cooperative learning (Johnson et al., 1991, p. 3:3) as a group of educational activities can be differentiated from group assignments and group work by the identification of specific qualities such as positive interdependence, individual accountability, heterogeneous membership, shared leadership, the emphasis of tasks and relationships, direct teaching of social skills, instructor intervening in groups, and group processing. Probably the most significant difference from less structured group work is the positive interdependence. Positive interdependence means that the learners are individually accountable for their own learning as well as the learning of the entire group. Cooperative learning requires the student to be interactive with other students to a much larger degree than normally expected during a typical college lecture or discussion (Totten, Sills, Digby, & Russ, 1991, p. 1).

The pairing of students to enhance higher order learning and critical thinking has been reported recently in nursing and medicine (DiCarlo & Rao, 2000; Van Horn, 2000). When students are paired, they work on a common intellectual product and subsequently receive a grade that is dependent upon the success of their interactions. When students work together in pairs they must communicate their common understandings but they also encounter differences that must be explored and resolved. The students’ interest and learning has an opportunity to peak when differences between the students arise. When a difference surfaces, students realize that there may be an opportunity for gain and a risk of losing. A difference can mean that one student has a better understanding than the second student or that there are two feasible options. If one option is better than another, the group is at risk because students could choose the wrong option but they also have an opportunity for success. It is the realization of the shared opportunities to lose and
succeed that motivates students to listen and problem-solve together, and this shared future develops a positive rather than a competitive relationship that is motivating. Pairing students necessitates the active involvement of each student, results in higher performance on quizzes, and demonstrates an improvement in higher order thinking (DiCarlo & Rao, 2000). For pairing to be classified as cooperative learning, however, it must include positive interdependence. Positive interdependence means that the outcome of each student is dependent upon the other students’ work. Placing students in pairs does not mean that learning will be maximized; in fact, it can be harmed. What largely determines whether this will be positive or negative is “how the faculty members structure the interdependence in the learning situation” (Johnson et al., 1991, p. 2:4). And the key structures that make the difference are effective positive interdependence and effective peer feedback. The effective use of “Peer Feedback” is when group members candidly provide information on how well they are “fulfilling their responsibilities and completing their work” (p. 2:7). So whereas in cooperative learning the emphasis is on active learning on the part of the student, the role of the teacher is more complex and is central to learning success, because the teacher has to know how to effectively organize group activities with positive interdependence and peer feedback.

Students may be placed into informal cooperative pairs in a variety of settings. They may be asked to journal with a partner as a reflective activity following clinical practice (Van Horn, 2000). A 50-minute class period may be divided into three or four short presentations interspersed with questions to be discussed in pairs, with the goal of improving retention and higher order thinking (DiCarlo & Rao, 2000; Lozano, 2001) such as analysis, problem solving, and synthesis as opposed to recall. Additionally, a
testing process may be used in which students are first tested traditionally as individuals and subsequently paired and retested (Johnson et al., 1991, p. 4:27). The purpose of testing and retesting is that it gives students who have committed to different answers the practice and incentive to communicate their own assumptions and to evaluate the assumptions of their classmates. Then they must negotiate a shared answer that communicates the collective outcome of the process—an answer to which they both contributed and both can agree. These are the kinds of communication, critical thinking, and negotiation skills they will need in the hospital. Alternatively, students may be assigned to provide peer teaching (Ellis & Foutes, 1993, p. 109). Cooperative learning methodologies involving pairs add to the menu of learning strategies to be considered in the development of critical thinking.

Another example of a cooperative learning strategy known to improve critical thinking is the academic controversy (Johnson et al., 1991, p. 7:5). Academic controversy may be planned through the assignment of opposing positions to be presented in a classroom. There are several classroom settings in which natural academic controversy may be augmented and used to improve learning. Academic controversy may be contrasted with debate, concurrence seeking, and individualistic learning. In a debate the students appoint a judge who then determines who won the case. In contrast, academic controversy requires students to share the reasons for their positions and to carefully consider possible contradictory reasons given by their partner. The contrast is that in academic controversy a student would be encouraged to change positions whereas in a debate the focus is more on winning and less on emphasis on the pursuit of truth.
Researchers Johnson and Johnson (1988) established the ability of structured controversy to result in an “increase in students’ perspective taking abilities, greater student mastery and retention of the subject and greater ability to generalize the principles learned to a wider variety of situations; higher quality decisions and solutions to problems” (p. 63). Concurrence seeking refers to those tendencies and actions observed when students try to come to agreement prematurely without carefully articulating the reasons for their previously held positions. Individualistic thinking or learning and classroom structures are emphasized in traditional learning contexts that are said to be competitive and antisocial because when one classmate does well on a test graded using the statistical assumptions of a normal distribution it can adversely affect the evaluation of the classmate (Johnson et al., 1991, p. 2:5). In such situations when one student wins, another loses. In contrast to these educational methods, the careful sharing of reasons and information and the consideration of the reasons provided by partners that is characteristic of cooperative learning leads to the kind of critical thinking needed in respiratory care. Respiratory therapists should not demonstrate their listening skills by changing their position unless the alternate position is superior. This careful listening attitude will also encourage others in the clinical setting to consider other points of view carefully and critically. The reciprocal sharing of ideas and information is necessary to gain the full advantage of each clinician’s unique expertise.

Johnson et al. (1991) compare the advantages of academic controversy over the learning outcomes seen in debate, concurrence seeking, and individualistic learning (pp. 7.3-7.5.1). Students participating in academic controversy were found to reach a higher level of both mastery and retention. They made better decisions when encountering
complex problems with several plausible answers. Students engaged in academic controversy were more creative and exchanged a higher level of expertise. Their emotional commitment also exceeded those participating in other modes of learning. Johnson et al.’s research has shown that academic controversy demonstrates elevated levels of learning according to several measures. Academic controversy, as well as other collaborative approaches, is likely to develop the particular skills in critical thinking that are necessary to the respiratory therapist. The ability to carefully consider alternate assumptions in an interactive environment with other clinicians is a key skill in the clinical respiratory context.

**Problem-Based Learning**

Problem-based learning (PBL) is a self-directed strategy advocated by physicians, nurses, and respiratory therapists, among others, for the development of critical thinking and clinical decision making (Mishoe, 1993, p. 33), in contrast to the traditional lecture format. PBL includes group work and loosely structured, or more lifelike, problems. Placing students in an interactive environment with their peers naturally requires them to consider alternate viewpoints and underlying assumptions. Students carry major responsibility for their own learning (Ceconi, Op't Holt, Zipp, Olson, & Beckett, 2008, p. 58). Furthermore, an ambitious group assignment will involve the kind of critical-thinking required of a graduate. Perhaps this is why PBL has such a wide range of professional advocates.

Respiratory care educators have identified various elements and components as fundamental to PBL. “The essential components of problem-based learning include an integrated curriculum rather than one separated into clinical and theoretical components,
curriculum organized around problems versus disciplines, and an emphasis on cognitive skills as well as knowledge” (Mishoe, 1993, p. 33). Three essential elements have been identified: the learners, the problem, and the tutor (Op’t Holt, 1994, p. 21). PBL can be seen as radically divergent from traditional instruction.

PBL provides the student with opportunities to actively and autonomously investigate and solve relevant problems in groups. While the resolution of a problem is important, it is not the primary goal. The main goal is to gain practice in using essential skills of critical thinking such as communication and negotiation. Success is dependent on the careful identification of the assumptions or evidence underlying the beliefs adopted by group members as well as the use of logic and reflection.

Participation by every member of the group is essential for a successful activity (Op’t Holt, 1994, p. 23). Students must share their thoughts, knowledge, and feelings with the group, showing a willingness to admit what they do not know and allowing the group to profit from the combined exchange of ideas.

A key way in which PBL differs from more traditional lecture-based instruction is that the problem is presented first, rather than following a presentation or lecture over relevant content. “Problems are presented as real patients or written case histories” (Op't Holt, 1994, p. 29). Students have the freedom to determine or prioritize learning issues, access a wide variety of information, and ask relevant questions regarding patient examinations, laboratory tests, and patient response to applied therapeutic procedures as they work through a given course.

Op’t Holt (1994, pp. 34-38) provided a careful and detailed review of research findings related to PBL. In this review, he reported findings typical of the complexity of
PBL outcomes. Interestingly, problem-based learning may not necessarily teach problem-solving skills. The report suggested that problem-solving ability might be more of an intrinsic characteristic than a learned trait. However, the review also found that PBL may initially reduce levels of learning but may foster increased retention of knowledge over periods up to several years. Problem-based learning may enhance both transfer of concepts to new problems and integration of basic science concepts into clinical problems, and it appears to enhance self-directed learning skills, and this enhancement may be maintained (p. 37). Op’t Holt (1994) concluded his review of relevant PBL research by advocating a respiratory therapy curriculum that seeks to capture the benefits of both PBL and the conventional curriculum (p. 38).

Recently Beachey (2007; Mishoe, 2007) examined several measures of program outcomes for two PBL and two traditional baccalaureate degree respiratory therapy programs. The program outcomes included employer and graduate satisfaction and National Board for Respiratory Care (NBRC) Certified Respiratory Therapist (CRT) and the Written Registered Respiratory Therapist (RRT) examination scores. The most important findings from this study showed that PBL graduates were not at a “disadvantage on standardized, objective tests of knowledge, such as licensing and credentialing examinations” and that PBL graduates were more satisfied “with the quality of their education” (Beachey, 2007, p. 1504).

More recently Op’t Holt, Ceconi and others (Ceconi et al., 2008) published results of their retrospective, correlational research comparing program data prior to and after implementing PBL in one respiratory care program that compared data from 1996-1999 with data from 2000-2003. “The NBRC Clinical Simulation Examination DM scores and
the PBL curriculum had a high positive correlation of \((r=.58, p<.01)\). This finding demonstrated that students from the PBL curriculum scored higher on the NBRC Clinical Simulation Examination than students in the traditional curriculum” (p. 61). This resulted in a 27-point advantage on the NBRC Clinical Simulation examination for graduates of the PBL program. Problem-based learning as implemented in the program studied was shown to improve decision-making skills. The implications are that PBL improves critical thinking because decision-making skills have been correlated in respiratory care credentialing examinations with measures of critical thinking (Mishoe, Dennison, & Thomas-Goodfellow, 1997).

PBL is an example of a method of organizing education that is learner centered and requires collaboration between students. Conclusions about the effectiveness of PBL have been considered tentative (Finucane, Johnson, & Prideaux, 1998). The implementation of PBL in one respiratory care program resulted in a 27-point advantage on the NBRC Clinical Simulation Examination DM scores over those students in the traditional curriculum. It is an important strategy because of the potential for improvement in measures of critical thinking, student satisfaction, and the enhanced development of autonomy in learning needed for clinicians to stay current after graduation. PBL has strong advocacy among respiratory care educational leaders.

Mishoe (1993) describes the heavy use of lectures in teaching as an inappropriate means of developing critical-thinking skills (p. 33). Instead, she recommends case-based instruction, PBL, and small-group discussion. Op’t Holt (1994) describes PBL as “an opportunity for health care education to rely less on lectures, memorization of facts, and the use of lower-order cognitive skills” (p. 18). PBL is recommended as a method of
radically reconstructing education to meet the need for developing the critical-thinking, problem-solving respiratory care practitioner. Op’t Holt (1994) characterizes problem-based learning as “an instructional method that provides students with the skills to solve problems and acquire information and stresses self-directed learning, independent and critical-thinking skills, and clinical reasoning” (p. 18). Op’t Holt (2000) provides a description of a first-year experience with problem-based learning. The greatest difficulty reported was the students in one group refused to believe that students in a different group were identifying the same learning issues and resource needs (p. 52). He noted that most students enjoyed the process and performed better than their predecessors on the National Board for Respiratory Care Entry Level Examination. Ceconi et al. (2008) have reported higher DM scores on the NBRC Clinical Simulation Examination for graduates of a problem-based learning program.

Mishoe (1997) calls for educational reform in respiratory care, advocating the implementation of problem-based learning. A primary justification for this recommendation is that problem-based learning requires the student to “work collaboratively with others; to manage time and resources; and to develop the skills and characteristics of a critical thinker” (p. 82).

Cognitive and decision-making ability can be improved by enhancing skills in evaluation and in using evidence (Mishoe & Welch, 2002). Critical thinking in practice is described as inductive reasoning about a large number of loosely structured problems that have no single solution. Decisions must be made in a context of uncertainty. The criteria on which to base decisions are often in dispute, and empirical evidence on effectiveness
of different treatments is often lacking (p. 513). Problem-based learning provides a venue for learning how to approach these challenges.

As a means of improving respiratory therapy training and subsequent patient care, Mishoe (2002) recommends that students receive greater “opportunities to engage in critical discourse in order to improve communication, negotiation, decision-making, and reflection” (p. 514). The elements of critical discourse include listening, sharing, and evaluating that are common to other interactive critical-thinking strategies. These are the activities that develop during problem-based learning.

In a 2002 editorial, after commending the Socratic method and problem-based learning, Mishoe (2002) writes that “we need further study of the effectiveness of educational strategies to promote the development of critical thinking and decision-making” (p. 568). Mishoe encourages more research in discipline-specific strategies to develop critical thinking because if the collective critical-thinking skills do not advance, the profession could stagnate in technical task-oriented service. Alternately, this profession may expand as patient and technical assessors, which would result in better patient care.

In summary, problem-based learning offers a strategy where students can learn the real-world skills of identifying issues, researching them, presenting knowledge, interacting and challenging each other and therein learning to think critically. Problem-based learning has demonstrated higher DM scores on Clinical Simulation Examinations.

**Critical Thinking in Respiratory Care**

In an effort to search the literature for journal articles on the subjects of critical thinking, decision making, reflection, and cooperative and collaborative education in
respiratory care, searches of the following databases were undertaken: Education Resource Information Center (ERIC), PubMed Central (PMC), Medical Literature Analysis and Retrieval System Online (MEDLINE), Proquest Digital Dissertation Abstracts, Wilson Select, and the American Association for Respiratory Care (AARC) website.

The online literature searches demonstrate a significant need for additional studies regarding the development of critical thinking through respiratory care education. Respiratory Care educators and authors Shelledy, Gardner, and Wettstein (2004) make this point by writing that, unfortunately, “it is not clear how to best teach critical thinking, and methods to assess critical-thinking specific to respiratory care are not readily available” (p. 16).

Nursing scholars have made a major contribution to the critical-thinking literature in healthcare. This is likely due in part to the critical-thinking accreditation outcome requirement of the National League of Nursing (Videbeck, 1997). The respiratory care literature contains faculty evaluative summaries and accounts of the implementation of critical-thinking-enhancing pedagogies (Beachey, 2007; Hagan, 1996; Op't Holt, 2000).

The published respiratory care articles may be divided into three general topics:


2. Correlation of measures of critical thinking with respiratory care credentialing examinations (Hill, 2002; Hixon, 1985; Mishoe et al., 1997; Shelledy, Gardner, Carpenter, & Murphy, 2004; Shelledy, Gardner, & Wettstein, 2004b)
3. Recommendations for strategies or approaches to assist in the development of critical thinking (primarily problem-based learning) (Mishoe, 1993, 2002; Mishoe et al., 1997; Mishoe & Welch, 2002; Op’t Holt, 1994, 2000; Shelledy, Valley, & Murphy, 1997).

Measurement of Critical Thinking in Respiratory Care

Goodfellow (1999) found experience to be key to the understanding of critical-thinking behavior in respiratory therapists. Facione, Mishoe, Dennison, and Goodfellow (1997, as cited in Goodfellow et al., 1999) support a statement that the Clinical Simulation Exam (CSE) from the National Board for Respiratory Care (NBRC) is one of the few domain-specific instruments for the assessment of critical thinking. Goodfellow et al. also reported on the validity and reliability of an empirically constructed, respiratory-care-specific critical-thinking instrument. More recently, Shelledy et al. (2004) reported the development and study of an instrument for the assessment of respiratory care students’ critical-thinking and problem-solving ability. This instrument was found to correlate well with Watson-Glaser Critical Thinking Appraisal ($r=0.54; p=0.02$) and NBRC CSE information gathering ($r=0.51; p=0.03$) and decision making ($r=0.74; p=0.0003$).

Goodfellow (2001, 2002) identified three types of respiratory therapists: (a) individuals labeled type 1, with highly situated problem-solving skills and high communication skills; (b) individuals labeled type 2, with low situated problem-solving skills and low communication skills; and (c) individuals labeled type 3, with highly situated problem-solving skills and low communication skills (Goodfellow, 2002).
In the earlier article, Goodfellow (2001) reported the self-ratings of various aspects of critical thinking by 975 respiratory therapists. These therapists rated themselves highest in prioritizing, troubleshooting, and communication, and lowest in anticipation. Goodfellow (1999) recommended the inclusion of situated cognition where one learns in the clinic or place of application; reflection-in-action entails “building new understandings to inform our actions in the situation that is unfolding” (Goodfellow, 1999; Smith, 2001, p. 10) and problem-posing in professional curricula in which the instructor and the student “teach each other” based upon the problems that naturally present themselves through the clinical environment (Freire, 2005, p. 80). Mishoe (1995, 2003) reports that critical-thinking in respiratory care practice involves the abilities to prioritize, anticipate, troubleshoot, communicate, negotiate, reflect, and make decisions.

Mishoe and MacIntyre (1997) published a paper as an outcome of the 1996 American Association for Respiratory Care International Conference on emerging healthcare delivery models and respiratory care, held in Cancun, Mexico. In this report, the work of the respiratory care profession is described as “complex, esoteric and discretionary” because “it requires theoretical knowledge, skill, and judgment that . . . people do not possess, may not wholly comprehend and cannot readily evaluate” (p. 72). Respiratory care is said to be “at a crossroads in its growth into a profession” (p. 73) because it could either become task oriented or it could grow into care management. Task-oriented care would mean that respiratory therapists operate as less intellectually skilled performers of procedures ordered by others, whereas care management includes intellectual skills in patient assessment and skills in directing care in harmony with protocols and clinical practice guidelines. Respiratory care has been rapidly expanding
into the use of therapist-driven protocols using clinical practice guidelines developed out of evidence-based medicine. Where at one time respiratory therapists were expected to follow orders given by physicians, for over 10 years medical directors have utilized therapist-driven protocols (Wood, MacLaod, & Moffatt, 1995), which are broad assess and treat protocols that require respiratory therapists to assess patients and determine appropriate treatment from a host of complex options. These protocols are based upon meta-analysis of clinical research known as evidence-based medicine and the support of prestigious physician organizations (Force, 2002). Now, physicians (Rubenfeld, 2004) label respiratory therapists as central to the translation of clinical research into clinical practice. The issues and opportunities of expanded scope of practice (Orens, Kester, Konrad, & Stoller, 2005) make a case for the inclusion of critical thinking as a core component of respiratory care curricula. According to Mishoe and MacIntyre (1997), critical thinking is not sophist thinking that can be relegated to academic exercises. A shallow definition of critical thinking would exclude elements of problem solving, speaking, writing and reading but the critical thinking required of respiratory therapists includes all of these (p. 79).

Respiratory care scholars are concerned about encouraging critical thinking where it will make a difference. For the respiratory therapist, critical thinking makes a difference when it is shared through written, verbal, and tacit body-language methods of communication. In speaking about communication, Mishoe and MacIntyre (1997) write, “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). 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). Other definitions of critical thinking may not emphasize communication, but for the respiratory care profession, thinking without communication is of no practical value.

What we see in published respiratory care literature is a consensus regarding the abilities that respiratory care practitioners actually exercise when practicing critical-thinking. Specifically, they are interactive and communicate with the people around them. Their critical-thinking includes both problem-solving and decision-making skills, but it is essential that the patient and the other caregivers are involved in the process. Respiratory therapists have a foundation of knowledge, and they use strong patient assessment skills and evidence-based protocols to make decisions regarding the allocation of their technical skills (p. 77). But “the development of cognitive skills and metacognitive strategies for decision-making are insufficient for decision-making in actual clinical practice. The allocation of cognitive skills must be communicated and negotiated, and are essential for decision-making and critical-thinking in practice” (p. 79).

Correlations With Credentialing Examinations

Based on a study of 312 research subjects, Hixon (1985) demonstrated a positive correlation between experience and clinical simulation performance. While the clinical simulation examination has been identified as a domain-specific measure of critical thinking (Goodfellow et al., 1999; Mishoe, 1997, p. 78), Hill (2002) reported a statistically significant correlation between critical thinking, using students’ scores on the Watson-Glaser Critical-thinking Appraisal-measured CT and the measured decision-
making score on the Clinical Simulation Self-Assessment Examination (CCSAE, developed by the National Board for Respiratory Care) for 110 students of \( r = 0.32, \, p < 0.01 \). Shelledy et al. (2004) reported a study of 36 first-year students from two area schools. The Shelledy study demonstrated correlation between Watson-Glaser Critical Thinking Appraisal scores and performance on the National Board for Respiratory Care (NBRC) Certified Respiratory Therapy Self Assessment Examination \((r=0.51; \, p=0.001)\) and Clinical Simulation Problem Information Gathering scores (IG) \((r=0.54; \, p=0.001)\). The study supports the supposition that critical-thinking ability may be useful in predicting student performance in a respiratory care program. The Beachey (2007) study did not show a difference between NBRC Certified Respiratory Therapist (CRT) and Written Registered Respiratory Therapist (RRT) examination scores between two programs using problem-based learning and two traditional programs. The Ceconi et al. (2008) retrospective study demonstrated a 27-point advantage in DM scores on the NBRC Clinical Simulation examination for students completing a problem-based learning program compared to students completing a traditional program. While these correlations are noteworthy, respiratory care educators must have concerns that encapsulate more than credentialing examination success. Educators must also concern themselves with speech and writing. That is, in respiratory care, improvement in critical thinking may include two quite divergent applications: An improvement in the interactive functionality in clinical settings, as well as student and graduate performance on credentialing exams measuring critical thinking.
Other Perspectives Regarding Educational Strategies

In a letter published in Respiratory Care, Hopper (2002) expresses doubt about several issues involving education and critical thinking. He doubts that decision-making scores on the National Board for Respiratory Care Clinical Simulation Examination actually measured decision-making in the pure sense. Instead, he asserts that students are taught to memorize a “few problem-solving rules,” and that they are taught “mastery of the gamesmanship element of branching-logic simulations” (p. 1019). He also doubts that critical thinking can be “instilled” in students (p. 1019). To Hopper there is “no evidence that CT can be taught to low-caliber students” (p. 1020). Hopper (2002) went on to say that “the dominant instructional method in respiratory care is lecture.” In a letter published in the same journal, Glenn Roberts (2002) also expressed his disbelief: “From my observations CT (critical thinking) and DM (decision making) are skills. They must be practiced, tested, and refined in order to grow” (p. 1018). Because Roberts does not believe that critical thinking can be taught or that the health-care environment fosters the growth of critical thinking he encouraged the use of measures of critical thinking in program-selection criteria.

Social Learning Theory Applied to Teaching Critical Thinking

Even those who advocate the use of active learning strategies represent their use as a challenge. For example, the ability to effectively organize cooperative learning has been recognized by researchers as more complex for the teacher and as requiring considerable training (Johnson et al., 1991, p. 1:7). This suggests that inexperienced or insufficiently trained faculty could ineffectively administer or initiate active-learning strategies. By contrast, are there principles that expert faculty believe and adapt to
strategies that enable them greater success? Social learning theory (Bandura, 1977; Vygotsky, 1978) offers a framework that aligns with this study regarding the principles that expert respiratory therapy faculty believe and successfully apply to the application of active-learning strategies. The expert application of these principles results in the learning of critical-thinking skills.

Social learning theory contends that learning occurs in contexts in which individuals are attentive to models (Bandura, 1977, p. 24) that demonstrate behaviors to be learned and observe or experience reinforcement (pp. 97-158). Additionally, learning occurs in the zone of proximal development (Vygotsky, 1978, pp. 86, 87) where the student can perform skills with stronger peers that she is unable to perform alone. Many educational strategies present situations in which there are these social learning models from which the student can learn.

A number of factors determine whether people will act on what they have learned (Bandura, 1977, p. 51). Students and faculty, their behaviors, and the environment are interdependent causes of behavior or learning (p. 9). Bandura states: “Outcomes change behavior in humans largely through the intervening influence of thought” (p. 18). People who are attentive to their own behavior and the behavior of others (models) within a bewildering variety of circumstances develop expectations of which behaviors will produce desirable outcomes under certain circumstances (p. 90). Modeling, attentiveness, thought, and reinforcement are factors that influence learning. In addition, students are more likely to demonstrate learning if they develop self-efficacy in the area of study. This self-efficacy is extended when students perceive their power to successfully interact in the environment to determine outcomes. “Superior accomplishments, whatever the field,
require considerable self-disciplined application” (p. 207). Once students notice the effect of their efforts, their level of self-efficacy increases and they develop elevated levels of self-reinforcing drive.

Even in the absence of external recognition some people become convinced of the value of their own “work and labor tirelessly even though their productions are negatively received” (p. 207). It is this belief in one’s self and ability to bring about positive change in the environment that provides the necessary motivation for student success. This self-efficacy can be developed by giving the student challenging assignments over which they have control. Once they have gained success self-efficacy grows and they begin to self-prescribe standards for their own work (Bandura, 1977, p. 130). Because the beliefs and practices of the expert faculty in my case study echo those articulated in social learning, in subsequent chapters I take social learning theory and connect it to my research data and propose a metaphor and a mathematical representation.

**Summary**

Civilized humans have been concerned about the quality of thinking for thousands of years. Many aspects of critical thinking have been described by various professional bodies and scholars. Critical thinking in respiratory care is broader than a mere reflective judgment regarding what one should think or do. It includes the ability to communicate and interact with people of various perspectives in order to arrive jointly at a superior decision.

General characteristics of teaching strategies that have been recommended for the development of critical thinking have been identified. These are an increased use of varied classroom strategies and collaborative teaching methods, including the use of life-
like complex problems. These strategies concern themselves with developing thinking processes while encouraging active learning.

Cooperative learning and PBL are two examples of critical-thinking strategies. Academic controversy is a form of cooperative learning that involves the students in an interactive, open-minded listening and speaking process. Pairing is also a cooperative learning technique and involves putting two students together to construct knowledge and solve problems. PBL is different from traditional, highly structured laboratory and lecture instruction. In PBL, the student’s exploration of a clinical problem dictates the direction of inquiry. While the goal of PBL includes developing critical-thinking skills, respiratory care educators recommend a curriculum which also benefits from conventional approaches such as case-based instruction, writing, and presenting. Respiratory therapists who are writing about education in peer-reviewed journals understand and appreciate “a repertoire of models that are very good for particular purposes” (Joyce, Weil, & Calhoun, 2004, p. xiii). No respiratory care scholar is advocating the use of one strategy to the exclusion of all others.

A review of respiratory care literature provides articles in several areas: studies of the measurement, assessment, identification, and descriptions of critical thinking; the correlation of critical thinking with respiratory care credentialing examinations; recommended strategies for the development of critical thinking; and skepticism regarding the ability of educational strategies to impact critical thinking. No case study exists describing the expert practice of respiratory care critical-thinking strategies as understood by a program’s faculty or the expert faculty’s perceptions of these strategies. Beachey recommended a realistic qualitative study that would help to identify how
context influences learning. Social learning theory offers a framework for understanding the factors that expert faculty believe are important in teaching critical thinking.

This case study provides a picture of the beliefs, strategies, and program components that expert faculty believe are important in developing critical thinking. It will demonstrate what faculty, known to be effective in delivering problem-based learning and producing graduates adept at critical thinking, actually believe. It will show how these faculty implement educational strategies and what program components they use to do this effectively. This study will demonstrate aspects of social learning theory and propose a metaphor and mathematical model to stimulate discourse and abstraction about education.
CHAPTER 3

METHODOLOGY

Introduction

The purpose of this study was to investigate the critical-thinking teaching strategies employed by respiratory care faculty and their current beliefs regarding those strategies. This investigation explores several questions and serves as a resource to the respiratory care authors, educators, and policy makers. This study was designed to address the following questions regarding current critical-thinking learning strategies used by respiratory care faculty in the United States: What are the faculty beliefs concerning the development of critical thinking? How are learning strategies consistently implemented by expert respiratory care educators to enhance critical thinking and problem solving in their students? What program components support the development of critical thinking?

Qualitative Methods Design

To answer the above questions, a single qualitative case study of a strong program nominated by expert members of the Committee on Accreditation for Respiratory Care was conducted. The use of educational strategies used in respiratory care programs in a tri-state area (Ohio, Indiana, and Kentucky) has been noted (Hill, 1999) in other research.
This study seeks to produce new data about the ideas that faculty members of an academically strong program have about what is needed to develop critical thinking.

In qualitative research, the primary epistemology is based upon the assumption that “reality is constructed by individuals interacting with their social worlds” (Merriam, 1998, p. 6). This research emphasizes the thoughts of the participants regarding what pedagogical approaches are effective in the development of critical thinking.

I chose to use the qualitative case study format because this method not only provides answers to the above stated research questions, but serves as a basis for considering educational theory and further research. Numerous authorities in respiratory care have made recommendations in favor of various critical-thinking learning strategies, but to the uninitiated these strategies may seem like mere abstractions. Eisner (1994) suggests that constructing these active educational tasks is “not easy” (p. 204). In a qualitative description, faculty may be able to more readily imagine or vicariously experience what it is like to be a faculty member or a student while these methods are employed (Eisner, 1994, p. 213). Descriptions and observations provide concrete examples of how expert faculty focus their efforts in the application of critical-thinking strategies, allowing others to envision themselves in similar situations.

**Purposeful Sample**

One program was selected using purposeful sampling based on the nominations of critical-thinking experts representing CoARC, the national accrediting body. The likelihood of finding important strategies for dissemination increases because this program has a reputation for excellent educational practice among critical-thinking experts at CoARC. Once three nominations were secured, both the amount of scholarly
writing coming from the program and the number of experts who nominated the program were considered. One program was contacted to negotiate and secure participation in the proposed research.

**Researcher as Primary Instrument**

The qualitative researcher is considered the primary instrument for data gathering and analysis (Cresswell, 1994, p. 145; Eisner, 1998; Merriam, 1998). When a study involves an exploration of the metacognitive, it must involve the only instrument that can detect, understand, and communicate in this realm—the researcher. The rationale and the cognitive models used and given by educators and students to determine the potential effectiveness of certain strategies are not measurable by any physical or observational methodologies. These constructs can be detected only through human verbal and nonverbal means of communication. Although human actions hint at actual cognitive constructs, it is through communication that the qualitative researcher enters the thought processes of those studied. Once invited into the participant’s mental world, the qualitative researcher may request that a certain model or construct be examined. The researcher may then compare the model with other systems of education or experiences that she already understands. Through this common associative process, the researcher comes to an understanding of the usefulness of the relationships observed and a better understanding of what is observed. At this point the researcher has an idea of what she might try in the classroom herself or what she might recommend to others.

In this case study, I first observed learning in the classroom and then recorded interviews that were transcribed. Each participant’s thoughts were recorded and coded using a cross-comparative method. Qualitative research is characterized by the
researcher’s observations and interaction in fieldwork. Interaction can enhance internal validity, so I submitted my understanding back to the participants in a member-check process. According to Merriam (1998, p. 204): “A number of writers suggest doing this continuously throughout the study.” This qualitative study sought to uncover the meaning attributed to educational activities and processes. During the interview I would periodically summarize the participant’s understanding for her validation. The member checks continued after transcription and in the theme-identifying phase as well.

My interpretations come from the perspective of 24 years as a full-time faculty member in respiratory care education. I have served both as Director of Clinical Education and Program Director for an Associate of Applied Science (AAS) program in respiratory care. A milestone in my career came in July 2004, when I orchestrated the transfer of our respiratory care program from Rogue Community College to the Oregon Institute of Technology, a member of the Oregon University System. I am now the Program Director of both an AAS and a Bachelor of Science (BS) program through the Oregon Institute of Technology.

Upon entering the leadership Ph.D. program at Andrews University in 1999, my interest in the art and science of education has intensified. My appreciation of and experience with active forms of learning, collaborative learning, systems of grading, and the use of technology to provide distance education have changed dramatically. It is these experiences that provided the filter through which I interpret what I saw and heard.

Data Collection

Data were collected as field notes recorded during classroom observation, audio-taped interviews with administrators and faculty, artifacts as PowerPoint slides and
course syllabi and review of program outcomes, and student formative and summative outcomes as understood by program faculty (Merriam, 1998) and as studied by others (Beachey, 2004). During the research process my biases, thoughts, and analyses were recorded often in e-mails sent to participants, to the dissertation chair, or to myself. This study describes what approaches faculty consider effective in the development of critical-thinking, as well as their reasons for these beliefs. An emphasis was given to recording how activities and approaches are used, implemented, and interpreted, that is, the teaching and learning experience. The interview data collected provide insight into the educational culture, and shed light on expert education (Ari, Goodfellow, & Rau, 2003).

Classroom Observation

Classroom and clinical observations were recorded as field notes. The field notes recorded the individual setting, for example, the laboratory. I constructed a form that prompted me to look for particular categories of data as recorded below in this section. An example of the use of columns to provide observational and associated interpretive or metacognitive understanding can be found on pp. 86-87 of Narrative Inquiry (Clandinin & Connelly, 2000).

I recorded information relative to what was unique about an observed class, such as its size, gender, and ethnic diversity; the professional background of the professor; and the lighting, heating, noise level, presence of distractions, amount of resources, chairs, desks, tables, access to the internet, software, and books. I paid special attention to recording indications of student and faculty affect. For instance, the students appeared interested and engaged in the subject. The students were on task as opposed to wasting
time. The students and faculty frequently used humor and smiled at each other. The students and faculty did not appear to be under stress.

Regarding the actual instruction, my notations included a record of time, the directions given by the instructor, and any sort of organizational system that the students followed. I could not access the handouts or resources provided to students, which they are expected to download from the university website and bring to class. The field notes recorded what the students and faculty were observed to be doing. This included a description of student and faculty body language as well as spoken communication. I also recorded my thoughts and interpretations of what I observed, using a form that allowed me to record various kinds of data in specific regions of the form. One section provided the record of activities; another, verbal instruction and student responses.

Audiotaped Interviews

After these observations were complete, I conducted faculty interviews using audio recording equipment and asked questions designed to determine faculty thoughts regarding the intent of classroom activities. Interviews were conducted with senior faculty as well as with those who had only recently joined the faculty ranks. I sought to ascertain how effective they perceived the learning environment to be, and how typical the interaction I observed was of their program and practices. Additionally, I disclosed my observations and thoughts for the participants to address, giving them the opportunity to clarify their thoughts. Interview forms facilitated the collection and written notations from the interviews and served as a reminder of questions covered.

Additional interviews were conducted with the program directors and university administrators to gain a sense of how the methods used in the respiratory care program
are understood and what administrative means of support may or may not be supplied specifically in light of these pedagogical approaches.

Audiotaped faculty and directors’ interviews inquired into two areas: (a) how they came to use critical-thinking pedagogies, and (b) their understanding of the program outcomes, such as examination pass rates or employer and graduate satisfaction survey results.

Artifacts

Photographs were taken of program classrooms, equipment, and laboratories. Sketches were made of the extensive offices, the respiratory therapy library, the meeting rooms, and the layout of other resources in the building. The faculty provided 28 course syllabi and 111 pages of PowerPoint slides. Of the syllabi it was clear that 21/28 or 75% gave points for active-learning assignments. Consistent with the faculty interviews, the syllabi designated the use of problem-based learning, verbal presentations with media, peer evaluations, data collection or research, development of a case study, class participation, asking questions, and pro and con debate.

The pictures and sketches document the level of resources available to this program in light of Ari’s (2007) study suggesting that resources should be considered when interpreting program outcomes. Additionally, institutional program information was collected from the internet.

Journaling and Field Notes

Following the interviews, I wrote journal entries detailing my impressions, thoughts, and analyses (Merriam, 1998, p. 238). I recorded the date and time of each entry as well as what was happening in my research processes.
Data Analysis

The analysis and member-check process was contemporaneous with data collection (Merriam, 1998, p. 151) and also followed the initial data collection. During interviews I frequently restated my understanding of what was said so that those being interviewed could immediately confirm or modify my interpretation. I recorded my thoughts in conjunction with the field notes collected. My thoughts were shared with participants in order to inquire into their appreciation and understanding of the observed events.

The critical-thinking strategies used were identified in the record of classroom observations. My perceptions of important aspects of classroom activities were shared in an interactive process with the corresponding participants (Merriam, 1998, p. 151). This allowed the faculty member to provide his or her analysis of how they understand what they are doing in the classroom.

Program artifacts in the form of sketches were analyzed in a similar interactive process. The data sketched were discussed with the respiratory care expert faculty during the interviews.

Although I began transcribing interviews in the evenings while on location, the process continued for several months following data collection. Transcribed interviews were returned to participants for correction. Subsequently, after coding, I sought to organize the data for better understanding. I compared the coded data with the education literature. I thought I saw similarities between the physiologic transfer of gasses in the body and the transfer of critical-thinking knowledge in a program. I sent my ideas back to the senior faculty and received their endorsement. The information was presented in an
iterative clarifying process to my dissertation chair. This resulted in a metaphor and a corresponding mathematical model. Subsequently, the findings and model were analyzed as to how they relate to the social learning theoretical framework.

**Validity and Reliability**

The opinions of the expert faculty are explored, recorded, and shared through the medium of this study. It is of utmost importance that the record of these opinions is accurate. To assure accuracy, the record of faculty opinions was reviewed by the participating faculty before being finalized for the report. This process is meant to be consistent with what Merriam (1998) referred to as member checks—“taking data and tentative interpretations back to the people from whom they were derived and asking them if the results are plausible” (p. 204). The member-check process was a participatory and collaborative mode of research.

The data collected came in the form of in-class observations, as well as faculty interviews, as the basis for their understanding of strategy success (Eisner, 1998, p. 110).

Member checks increase internal validity by ensuring that the researcher does not mistakenly misrepresent the ideas and opinions of the expert faculty under study (Eisner, 1998, p. 112).

I collaborated with the program faculty by way of member checks in order to facilitate accurate understanding of the findings. The expert faculty studied have an established interest in research and are skilled at analyzing data. The interest and collaboration by participating faculty provide an additional source of validation.

The researcher’s biases, worldview, and theoretical orientation were described to key participating faculty at the outset of the study during the Institutional Review Board
(IRB) approval process. This declaration provided insight to participants of the study regarding the influence such biases were likely to have on study outcome.

**Generalization**

The knowledge gained from a case study involving the analysis of nine interview transcriptions is different from a randomized controlled trial with a treatment group and a control. Because educational “conditions and contexts vary” (Eisner, 1998, p. 208) so much of the information presented in an educational case study is not a “prescription to follow” but rather the presentation of “ideas to be considered” (Eisner, 1998, p. 209). Qualitative case studies are said to be “full of opportunities for generalization” (p. 207) but these should “be shared and discussed, reflected upon, and debated” (p. 205), because it is the readers who must determine if findings can be applied to a particular workplace.

**Institutional Review Board (IRB)**

To meet IRB requirements for the participating institution, I submitted the required research protocol and informed consent form. These protocol and consent forms were repeatedly revised in compliance with IRB recommendations. The protocol was classified as an educational case study and approved as exempt from full review. I submitted current CVs for both the dissertation chair and myself and obtained a faculty sponsor from the participating institution. No conflict of interest was identified. In addition, I completed the required Collaborative Institutional Training Initiative (CITI) web-based education and provided evidence of mandatory Health Insurance Portability and Accountability Act (HIPAA) training.

Following approval by the participating institution’s IRB, I applied for approval from the Andrews University IRB. Changes to the informed consent required by the
Andrews University IRB were subsequently approved by the participating institution’s IRB as well. The process of obtaining IRB approval from these two institutions took 7 months. Written permission to interview faculty was obtained from the administration of the participating program and submitted to the Andrews University IRB and approved. The research protocol was limited to the interview of faculty and the observation of classroom and laboratory activities. Because the study questions are limited to faculty beliefs and practices and the IRB requirements necessary to sanction student interviews and clinical instruction would have added significantly more time for approval, the protocol did not include interviewing students or observing instruction in a clinical facility.

Artifacts and notations collected during this qualitative study may contain information that can directly identify the subjects. These data are kept confidential and secure. The names of subjects, institutions, or identifying links will not be included in any publication of study results. Faculty who wished to participate by being interviewed or observed as part of the qualitative study were required to complete an informed consent form (see Appendix). Prior to every classroom observation, a standard announcement was read to the class informing them of the presence of the researcher, the purpose of the research, and their choice to refuse the observation without consequence.

This study was carried forward with respect for the participants. Subject participation was voluntary and informed. I remain committed to the goal that no individual or organization will be put at undue risk.

In summary, this study involved a purposeful sample, single qualitative case study in which I traveled to the University, observed classroom activities, and interviewed nine
faculty members. The audiotapes of the interviews were subsequently transcribed and returned to participants in a member-check process. Subsequently they were coded and mined for relevant themes using a cross comparative method. The data are presented using the social learning theory framework and a mathematical model with a corresponding metaphor.
CHAPTER 4

RESULTS

Introduction

This chapter is organized into four sections. The first section describes the University as a whole, and focuses specifically on the respiratory program and program faculty. The second section describes the respiratory faculty’s beliefs regarding developing critical-thinking in students. The third section deals with faculty beliefs about effective strategies to develop critical-thinking. The last section identifies the program components that faculty identified as essential in developing critical-thinking.

Eastern Medical Science University

Eastern Medical Science University (EMSU), a pseudonym, is a state institution with a long and distinguished history as a school of medicine. The medical school was founded in the early 19th century. It survived both the devastation of the Civil War and the Flexner Report of 1910, which resulted in the closure of numerous medical schools and a move to close the school for financial reasons soon after the Depression. The University remained solely dedicated to the study of medicine until the middle of the 20th century, when a school of nursing was added. Later, the school of graduate studies, the school of allied health, and the dentistry and Ph.D. programs were added. Degrees from EMSU are highly respected by health professionals.
This research university is located in a city of around 200,000 where the ethnicity of the population is 50% African American and 45% White. Within a mile of the University are two adult hospitals with over 1,000 beds collectively, a children’s medical center with 154 beds, and a Veterans Administration hospital with 278 beds. There are also numerous clinics and health-care specialty centers located in the area including a 13-county level-1 regional trauma center. The University is acclaimed for many significant contributions to health-care as a result of its efforts in research. Researchers from EMSU pioneered the measurement of pressure pulses during cardiac catheterization. They developed a cure for pellagra and achieved breakthroughs in both birth-control pills and beta-blocking drugs. The University’s mission encompasses the reduction of illness in society at large and a vision to become one of the nation’s premier health sciences universities.

EMSU is regionally accredited to award 1-year and advanced certificates and degrees at the baccalaureate, master’s, first professional, and doctoral levels. Each program maintains accreditation by the appropriate accrediting body. It is the only university in the state dedicated exclusively to the health sciences and it is growing. Four new buildings were recently constructed: a research center, a wellness center, an allied health sciences building, and a cancer center.

Respiratory Care Baccalaureate Program

The respiratory care program is described in terms of people, physical resources, culture, organization, and professional engagement. The number of highly qualified faculty is impressive. There are nine full-time faculty members, including the department head, the program director, the clinical director, and the dean of the School of Allied
Health, who is also a respiratory therapist. The department also has two adjunct faculty members and lists four co-medical directors; one is an emeritus professor of medicine. The program faculty and medical directors collectively have seven doctoral degrees. Collectively, the respiratory care faculty hold three Ph.D. degrees and eight master’s degrees. The program also has a full-time office manager and an administrative assistant. In March of 2007 the program had 16 juniors in attendance, three men and 13 women. Typically, about 15 seniors graduate each year.

To house both faculty and students, the University recently built a new allied health building. The respiratory care department, housed within the new building, has nine faculty offices, a conference room, a library, a lobby, and offices for the office manager and office assistant. This complex also includes a staff coffee room, a room for the departmental copy machine, two large storage rooms, a media room, and a research laboratory. A research pulmonary function laboratory is on a separate floor within the same building. In addition, the program has two large laboratory rooms equipped with the latest ventilators and advanced test lungs. These labs are wired with high speed internet and projection systems, and have piped-in compressed gases and suction. A third lab is for simulation, housing radiograph view boxes and high-fidelity manikins. The program also uses a designated classroom for lectures.

The culture of the faculty revolves around a desire to offer the best educational program in respiratory care. This is evident in the pride that faculty and students express in their resources, their association with the University, and their plans for the future. Faculty share a common mission: to change respiratory therapy for the better and
improve patient care. Students, faculty, and staff are congenial, professional, and passionate about their work.

The program is carefully organized to enable success. The student handbook is current, candid, and precise. Additionally, faculty are fully engaged with the American Association for Respiratory Care (AARC) and encourage student participation. Program faculty frequently publish research in peer-reviewed journals, present at national conferences, and encourage students to submit papers and gain membership in honor societies.

Respiratory Care Faculty

This study focuses on the beliefs and practices regarding the teaching of critical thinking by a group of 9 expert respiratory care faculty in a strong program. A background for these beliefs and practices is essentially tied to the experiences and education of the faculty studied. This section gives only a very general idea of past faculty experience because the research guarantees anonymity. Consequently, the names of faculty and many identifying characteristics have been changed. Because the experience and education of the faculty in leadership are substantially greater than that of the newer faculty, and because the leaders have a greater influence upon the program values, these two groups are presented separately.

Faculty in Leadership

All three faculty with Ph.D.’s hold leadership positions, having entered respiratory care during the 1970s. Two of these faculty leaders are men: Associate Professor and Department Chair Dr. Moore, and Associate Professor and Program Director Dr. Purcell. Professor and Dean of Allied Health, Dr. Walker is a woman. Drs.
Moore and Purcell entered respiratory care as on-the-job trainees after completing bachelor of science degrees. Dr. Walker started with an associate’s degree in respiratory therapy, followed by a bachelor of science degree, and began teaching after graduation. From initial entry into the program to achievement of a faculty position ranged from less than 5 years to 15 years for these three individuals. Both Dr. Walker and Dr. Purcell began teaching with bachelor of science degrees and completed master’s degrees and Ph.D.’s while members of the faculty. Dr. Moore did not begin teaching respiratory care until after earning a Ph.D. and completing post-doctoral studies in physiology. Each of these faculty members demonstrated a passion for the respiratory care profession and the role of education in improving the profession and patient care. They were convinced of the value of the educational principles they applied to motivate students and develop critical thinkers and were articulate in explaining the rationales behind them.

Two additional faculty leaders are Mr. McFarland and Ms. Kennedy, both assistant professors. McFarland is the Director of Clinical Education and is currently a Ph.D. candidate. He entered respiratory care through EMSU’s bachelor of science degree in the early 1990s, immediately began clinical teaching following graduation, and subsequently completed a master of science in physiology. He is now working on a Ph.D. in education. McFarland shares the other leaders’ passion for producing the best respiratory care program and the most well-prepared graduates in the world, and he articulates this passion well. He is equally vocal in describing the educational methods that he feels are effective. Kennedy is Director of Admissions and holds a Master’s of Business Administration (MBA) degree. The high number of doctorates and master’s degrees within this program underscores the findings of Ari (2005, p. 66), which
demonstrated better program outcomes with larger numbers of graduate-prepared faculty in respiratory care programs.

**Other Faculty**

Four of the subjects interviewed do not hold leadership positions at the University. Two of these were women, Assistant Professor Ms. Leigh and Assistant Professor Ms. Grover, and one was a man—Emeritus Associate Professor Mr. Yates. A fourth individual, Ms. Clark, referred to herself as “professional staff,” rather than faculty, because she does not hold a master’s degree. While these faculty members do not hold leadership positions, they do have a long history of experience in the respiratory care profession. Mr. Yates entered the profession in the early 1970s. Ms. Grover has almost 30 years of experience in respiratory therapy. Yates holds a master’s degree in education and Ms. Grover a master’s in biology. Each faculty member expressed pride in being part of the University program and held strong opinions on education, respiratory care, and educational methodology.

**Faculty Beliefs on the Development of Critical-thinking**

According to Bain (2004, p. 36) the strength of faculty beliefs is important because: “If the students see you pursuing that [their own enthusiasm for the subject], with all your heart, all your soul, and all your might, they’ll respond.” Teachers have been shown (Marzano, 2003, p. 72) to be very important determiners of student learning. Brophy (1998, p. 22) encourages teachers to look at themselves as their “most powerful motivational tool.” The strength of faculty beliefs is therefore recognized as a powerful director of attention and a determinate of success. Faculty will exert their effort and their influence toward what they believe is effective in developing critical thinking.
Faculty did not use a common phrase to define or describe critical thinking. Neither was there consensus in what faculty identified as the primary method of developing critical thinking in students within this academically strong program. Rather, the faculty agreed that it was everything they do collectively. There was, however, marked agreement among the faculty on the general principles of instruction necessary for the development of critical thinking. For example they agreed that students must be encouraged to “learn by doing,” and that small classes, such as those used in problem-based learning, are most effective. The faculty felt that they limit student growth in critical thinking when they do too much for them or provide them with too much information.

The faculty understand critical thinking to be more than the ability to recite facts. It involves the integration of copious information in making complex decisions. It is a contextualized knowledge that results in success in an ever-changing, fast-paced work environment. Walker says, “I view critical thinking as liberating a human being to excel.” Critical thinking allows a respiratory therapist to influence decision-making in a variety of hospital contexts. It can be difficult for respiratory therapists to adjust to the changing environments in different hospital settings. McFarland characterized this tension by saying, when “you step into one community, they love you; you step into another community, and they don't even know you.” A student or respiratory therapist who is able to engage with physicians and nurses, analyze a situation with people they just met, and provide a rationale that results in a better decision for a patient has the critical thinking that provides expedience. Critical thinking builds confidence-enabling success in new potentially hostile environments.
Critical thinking enables the respiratory therapist to dialog with other clinicians.

Clark says:

A program should establish the critical-thinking skills, and the integrity to think about the whole picture, and stand up to the physicians if necessary with justifications on how or why this [a particular action] is or is not what the patients need.

Walker takes this further by saying, people “need to really learn to be effective professionals in how to disagree with someone and still be liked and still have teamwork and rapport.” Critical thinking involves the facilitation of effective group thinking, which benefits the therapist and results in better decisions for the patient.

During the interviews, the faculty described a broad range of elements they felt were important to the development of critical-thinking. The faculty did not show a willingness to limit their discussion to a few critical-thinking strategies. Instead their beliefs represent a holistic view of what is needed to develop critical thinking. The faculty felt that how teachers motivate students to learn by doing was accomplished by using educational techniques such as applying knowledge together, solving problems together, participating in discourse, teaching, and peer evaluations. The faculty also felt that teachers must motivate students when using the strategies of problem-based learning, evidence-based practice, the whole body approach and reflection. They also recognized the contribution of several program elements as required for the enhancement of critical thinking. These elements included the selection and orientation of students, beneficial faculty-to-student ratios, quality clinical education with an integrated curriculum, and special measures to prepare graduates for graduation followed by program assessment.
Motivation

Expert faculty spent a lot of time discussing their own motivation, the motivation of other clinicians, and the motivation of their students. The first section will describe what was said about the motivation of faculty. The following section will describe what is done to motivate students.

A Motivated Faculty

The faculty had a considerable amount to say about their own motivation. Dr. Purcell stated that when recruiting new faculty members, we “try to look for folks that are passionate.” McFarland establishes the importance of passion in a faculty member by adding, they “don’t have to be the smartest or the best but at least have a drive to take care of people.” Moore agrees, saying give “me passion, experience and a willingness to go with our vision and strive for the best.” The general consensus was that faculty cannot motivate students if they lack passion and enthusiasm themselves. To provide contrast, Purcell talked about the poor motivation that can be found in other respiratory therapy programs saying, some “of these guys are probably drier than the dust and some of them are lame.”

Grover recognizes the value of the way that EMSU uses University faculty to provide instruction in the hospital, and this is a motivating factor for her. “I really love the connection between the clinical arena and the students being with the faculty.” The faculty themselves are all motivated to excel. Yates commented on the 5-to-10-year difference between findings in the published literature and the application of this research in the hospital. This motivates him to keep the program up to date. Yates also spoke about other areas that motivate him:
It was very stimulating to learn physical sciences and put the body together. . . . It was pretty fascinating to find out how much of a machine we were, and I was motivated from that standpoint, so I actually loved taking science, and applying it to the body, and making a difference in the outcome by how you treat it.

Some faculty have had dreams of producing better ways of representing and delivering instruction to students. As advances in technology develop, motivation increases as it becomes feasible to make these dreams a reality. Yates has been waiting for 10 years for the technology in mechanical ventilation to advance enough so that he could download the screen on a ventilator and integrate these screens into case-based instruction. “That’s really a fun thing” Yates says. Walker marvels that she gets paid to learn: “Some days when looking at what I am doing in my work and realizing that, you know, I am in a seminar, learning something on genomics and it’s part of my job.” Walker classified this recognition as “a high intrinsic motivator.” According to social learning theory, people learn by observing other people receiving rewards for behavior in what Bandura (1977, pp. 117, 125, 127) termed “vicarious reinforcement.” If students observe the faculty show enthusiasm for what the students are to learn, they are likely to conclude that this learning has been rewarding to the faculty and will be rewarding to them as well. Passion and motivation are key (Bain, 2004, p. 78) to the best teaching. Faculty will be more successful in motivating students to learn to think critically if they are motivated themselves.

**How Faculty Motivate Students**

According to Dewey (1939, p. 618), “the problem of method in forming habits of reflective thought is the problem of establishing conditions that will arouse and guide curiosity.” In preparing for a class, the best teachers (Bain, 2004, p. 49) think about what they can do to help and encourage students to learn. Researchers recommend that
teachers take actions (Marzano, 2003, pp. 149-151) to enhance motivation and not expect that it will simply happen. The faculty in this study did not believe that student motivation just happens, rather they give serious thought to how they can best motivate their students to excel and become critical thinkers.

Faculty believe that several methods best motivate students. For instance, they believe that candid feedback motivates students to honestly evaluate their thinking and progress. When students successfully finish challenging critical-thinking assignments they are motivated—especially when these assignments were initially frustrating. The faculty believe that it is motivating when students can see the effectiveness of their critical-thinking approaches. Even though the assignments are tough, they know the difficulty will help them achieve growth as practitioners. Generating strong emotions in students is also considered motivating, and faculty want to help students develop a fascination with the application of critical thinking. The faculty aim to keep the intensity of assignments at the right level, providing recognition and incentives for participation. Prompt feedback motivates students taking classes by distance learning.

As a means of motivation, Purcell tries “to be real honest” with his students. He aims to “give them confidence” and “boost their self-worth.” He says, my “job is not to make them feel bad or belittle [them] by any means.” He does wants them to earn this confidence and to have it because they deserve it, rather than as a result of flattery. He will not tell them, oh, “you are wonderful” when their work is not meeting the high standards of the respiratory program. He points out their mistakes, but also makes sure to praise exemplary work. He gives “specific feedback” and tries to keep it as private as possible, but he is not afraid to tell the truth and enter into an honest dialogue. He
believes students appreciate that he is up front with them and that it helps their personal growth, gives them an accurate sense of where the bar is, and how close they are to achieving good results.

Faculty make fairness a priority in dealing with students. Purcell gives the example of imperfect test questions, and says he will always favor the student and discard a disputed question: “A bad question is a bad question.” Purcell also allocates partial credit on tests to encourage this sense of fairness and motivation if the student can give him a logical argument to explain a particular answer on a test that he would otherwise perceive as wrong. Even if the student’s argument is not perfect, but “they are showing logic and reason and good thought,” because reasoning, logic, and good thought represent the foundation of critical thinking and in order to encourage critical thinking, Purcell will give them partial credit for the answer given. Students sense this attitude of fairness and it motivates them to try to communicate the basis for their assumptions, creating a bond of loyalty to the faculty member. When a person first tries to ride a bike or drive a car there can be a temporary period of frustration before the skill is mastered. Likewise, if a student is unaccustomed to the challenges of critical thinking, trying to overcome them can be frustrating. Once the critical-thinking challenges are surmounted students are attracted to them. Moore says once the students “get over the frustration they come to like the process.” The students recognize that the faculty member is there to help them, which is motivating. For this reason, it is very important that faculty care is genuine.

Good instructional approaches are also seen as important in motivating students, and many of the faculty have specific techniques they are passionate about. Moore provides an example by saying, my “passion is that I am going to ask them questions.”
He lets the students know that he is “not going to read the book back to them.” He insists that they put the information in context. He makes it clear that it is very important for them to know the information in the text. Moore says, “I care less about the ‘what’ than the ‘why’.” He also cares about the how—as in students will apply the information in the context of patient care. It is this ability to not only understand the research and the physiology behind knowledge but also the ability to communicate these rationales in the clinical setting that make up the critical-thinking objectives of the program.

What drives the way the faculty organize education is their sense that it is the highest priority. Moore rhetorically asks the students, when “you graduate from this program, if I come to the ER and see you in the room with my child, will I say ‘OK’, or I am I going to watch?” He then answers his question, you “will not get out of the program if you cannot pass that kind of muster.”

Faculty said that they used peer review, with students evaluating the participation of their partners on a common assignment. These peer evaluations became part of the students’ grades. Using a system like this is important for the development of critical thinking because when it works well it increases the quality of each student’s participation in the group. It also compels students to “learn by doing” in critical-thinking activities at a level similar to what would be expected of them in the hospital. That is, they will need to use candor and sensitivity to communicate their view of a situation when there are potentially emotional ramifications for all involved. Because students have little if any prior experience with this kind of peer review, they have a tendency to score their partners leniently, or complain about the process. The potential for emotional resistance such as this makes the implementation of peer review difficult. When
discussing the difficulty of faculty implementing student-to-student peer review systems, Moore said, “I think you have to have a fire in your belly for that” because it is such a hard thing to do. There is much to learn in respiratory care and without the benefit of passion and emotion on the part of the student, the information could be forgotten or become boring. In light of this, Moore aims to generate emotions in his students, “When they have pain, joy, anger, sadness,” whatever their emotions and frustrations are, he thinks to himself, “Now I got you.” Because it can be challenging to initiate student peer review and to generate emotions in the students, the faculty are conscious about the role that their own passions and convictions play in the process.

Providing a scheme that will help students understand the body excites Yates. He said that even students with good grades “are not that motivated” and as far as being ready to actually apply themselves and think critically, he says, “forget it.” Yates feels that the students are probably excited to be in a professional program with high levels of responsibility and technology, but they lack the commitment to learn difficult concepts and make sense of large amounts of details and data. Students who become enthusiastic and fascinated with how things operate are the ones the faculty see as most likely to be successful. It is the recognition of beauty, interest, and a sense of discovery that Associate Professor Yates identifies as key motivators.

When a subject such as mathematics is kept close enough to its application, its value is recognized and people are more likely to be fascinated. A problem with instruction in mathematics is the observation that it is often too far removed from its application. Once students are able to find its application, however, they are more likely to love it. Significantly, faculty use emotional words like “love” and “hate” when
discussing the learning activities they create. This is because “emotions play a prominent role in motivation” (Marzano, 2003, p. 147) and can “chart the course of moment-to-moment” actions. The fact that faculty frequently name the emotional responses of their students to learning activities provides a confirmation that they are tracking these motivational interrelationships.

Blevins showed her attention to motivation when she communicated her worry about class pacing. She worried that her class pace was too slow to keep her bright students motivated when she says, “I almost make it so slow that the top percent of the class are bored.” Blevins did not present a solution to her concern but her comment illustrates an attentiveness to how course delivery affects motivation. All the faculty pay similar attention to the motivational aspects of learning activities.

The faculty found that when they gave the students loosely organized problems that the students needed to clarify and research, they still needed to proscribe certain parameters. Kennedy said, “And we found that if we don’t give them deadlines, they will do it too late.”

Participation in class is another important motivator. Kennedy’s students are required to post observations online as part of the participation element of the class. Classroom participation is also carefully tracked and graded by Moore. He related how his class wanted recognition for their participation. He said they wanted him to say, “Bam” when they answered a question well. “It started as a way to ease the tension of answering a question and stuck.” Moore recognizes the necessity of an expectation of participation; you “will have everybody fill up the back seats first. It is like the back seat of the churches.” He does not believe that you will achieve a meaningful conversation.
without requiring full participation from students. In one syllabus, attendance and participation counted as 10% of the final grade, while in a second syllabus it was not mentioned in the course grading scheme. In one case, the students did not want to go to a state conference. While not forcing the students to attend, faculty gave such a difficult alternative assignment that the program had 100% participation. The conference was actually greatly appreciated by the students who were glad that they went. Moore explains, all “of the sudden they get some hands on laboratory, and they hear people and they like it.”

Because of the Internet, web-based education provides easy access to learning materials and faculty feedback. This proximity can help motivate the student when off campus. Web-based resources are provided for examination review. A problem-based learning (PBL) course has been converted and placed online. All classes are videotaped and quickly placed online for students to access. Faculty are working on placing courses online. Distance education technology is seen as a method whereby programs can share resources and complement each other. The faculty in this program see distributed learning as a way to complement other learning activities.

The program celebrates the required community service students provide in asthma camp. In the spring, children with asthma travel to a resort and the respiratory care juniors plan for this. The juniors take part as counselors, they organize the asthma self-care educational sessions, and are able to participate in the assessment of the campers and their medical care. Grover uses asthma camp as an example of the kinds of challenging activities that result in a motivation that springs from student pride in what they do:
We allow them to go out there and get this done and shock us and then they come back with that little bit of wow... And so its stressful and they resist but when it’s all said and done they come back going ‘Wow’.

Program faculty are concerned about the internal motivation of both faculty and students. They work to foster internal motivation and are not afraid to use external sanctions and rewards to pressure students into doing what is needed. They recognize that external motivation or force is sometimes needed to get the students to do the right thing. In the above examples, students became internally motivated by the challenges presented.

Learn by Doing

The faculty are unanimous in maintaining that students do not learn by being given too much information. Students do not learn by being told what to learn and how to think about what they learn. Students learn by doing and by looking things up (Bouton & Garth, 1983, p. 78; Caffarella & Merriam, 1999, p. 224; Ceconi et al., 2008, p. 58; Kuhn, 1996, p. 47; Tyler, 1969, p. 39). When it came down to learning McFarland said, “When you actually do it in the clinic” everything comes together. Clark also maintains that there are people who learn better by writing or hearing or seeing, but she continues, “I think the predominant method of learning is by doing.” Kennedy pointed out that faculty can only present so much information and that students need to look things up themselves.

Learning involves a lot of work for both the faculty and for the students. Students must participate in class discussions in order to gain the greatest benefit from instruction. Rather than simply being handed information, students must read and discuss it. Kennedy also says, “Listening to a lecture is one thing, but I learn by doing.” Even in the clinical setting Clark continues the same train of thought when she says, “I am trying to structure a lot of my questions around critical-thinking.” When she has a patient in distress she
asks the students about the temperature and the blood gases, and then she tries to have them tell her the next step, “rather than me telling them.” She tries to have them work through what they think is going on with the patient.

Purcell views lecturing as an instructional methodology that is tedious and from which people retain very little; “I don't expect them to focus every second on what I say.” Kennedy adds, “Just sitting there and listening to lectures is boring.” Clark has personally experienced greater learning retention from PBL: “I really did retain that information more than from a general lecture.” Yates went as far as to brand lecturing as a waste of time. Walker made a similar point:

Just because a teacher is up there talking about facts does not mean your student learns a darn thing. So we tend to think that if we are teaching it, people are learning it. You are wasting time, yours and the students.

It is a paradox that while each instructor does some lecturing it is still described disparagingly and considered by many to be a waste of time. It appears that the faculty are either using hyperbole in their reactions against the lecture model or are constrained by tradition or policy to follow the common university practice of lecturing. Perhaps the faculty communicate the ineffectiveness of lectures to help themselves focus their efforts toward the inclusion of learning strategies known to develop critical-thinking.

Lectures are video and audio recorded so that the information can be accessed later in recognition of the fact that students are less likely to retain information heard once in a lecture. PowerPoint slides are developed prior to class and those submitted demonstrated multiple high-quality illustrations. Some included selections by medical illustrator Frank H. Netter. Expert faculty also use Socratic questioning and student participation, their designated “lectures” providing a higher level of interaction than that
found in many lecture-based classrooms. Faculty frequently use technology to keep the students’ attention, even if this involves some level of entertainment.

**Effective Strategies to Develop Critical-thinking**

Critical-thinking educational strategy is defined as “patterns of instructional effort” (Koepke, 1993, p. 11; Weissman, 1990) designed to develop critical thinking. These patterns include complex sequential and recursive educational activities (PBL) made up of a number of exchangeable techniques such as questioning and peer review.

When expert faculty were asked to describe the primary strategies their program uses to develop critical thinking, they listed one complex well-studied learning strategy (PBL) which is very similar to the cooperative learning structure Co-op Co-op (Kagan, 1992, pp. 19:2-19:7). They also described evidence-based practice and the whole-body approach. The latter two have not typically been described as educational strategies. The faculty also use reflection and several educational techniques.

While a number of strategies are used to develop critical thinking, the ways that they are implemented are consistent. The strategies are implemented with student access to large amounts of literature, computers, laboratories, and attentive faculty. They are completely organized prior to implementation and the organization is designed to require the student to be active and accountable. Students must make recommendations and then verbally provide the evidence or reasons for those recommendations.

**Educational Techniques**

The faculty said they do not advocate only one strategy. The educational techniques included applying knowledge, solving problems together, discourse, teaching, peer evaluations, and answering questions.
Applying Knowledge

Students must apply and explain how they apply what they have learned to real problems even though this is difficult (Stice, 1987, p. 95). Purcell said that they try to test at least using application questions, “not pure memorization questions.” They give the students exercises and tests that involve thinking through solutions to problems and application questions. Purcell balances this by saying, “On the other hand I just gave them a test and if they could not give me five ways to assess that they have intubated then they are missing points because, there is more than five anyway.” The rationale that he provided is the importance of the topic: “They are the experts in airway care and if they don't know how to tell if they put the tube in the right place, that's nuts.”

Balancing this were the statements by Yates who considered memorization to be a pretty basic requirement for anyone entering respiratory care. He maintained that it is impossible to think critically without data to think critically about, “I mean, it’s a necessary function to memorize stuff. You’ve got a library up there to draw data from at will. If you don't memorize . . . , you don’t have any data to bounce ideas off of.” Yates gave the example that if a patient has a saturation of 90%, the clinician must know immediately that this is associated with a PaO2 of 60 torr. Overall, the faculty recognized that students must know basic facts and information, but they do not want to have their instructional time monopolized by the learning of facts. Walker says, “If there are facts that need to be learned, figure out how the student is going to learn them, not you talk about them.”

When students graduate they will need to function independently of the program and program faculty. When students ask Purcell for information he rhetorically asks,
“What makes sense to you?” then he provides an explanation for his question by saying, “Eventually you are going to graduate and I’m not going to be here.” Then he tells them that they will have to learn how to make their own decisions. Leigh maintains that students need to be responsible for their own processes of finding information to learn. She contrasts this with giving the students “too much so they don’t have to search for it” and “they don’t have to get an understanding for it.” But she says that in this program the students do gain an understanding because of the way faculty deal with questions. The students are told, here is what you need to know and how you need to know it, “but you tell me why.” Students are told to come back with good input and then the students and faculty will talk about it. This discussion will include everybody’s perspective so that they learn from each other and from the instructors.

**Solving Problems Together**

Students need the ability to use their own minds to analyze problems, developing and implementing solutions to those problems. For this reason the program does not want to give the students all the objectives, which would rob students of the opportunity to determine what is important for them to learn. Telling them exactly how to do an assignment would rob them of the intellectual work of solving a problem. There were many different places in the program curriculum where faculty may appear callous or disinterested, because they purposefully withhold the information that the student requested. Clark said that rather than handing students information, they “must read and discuss, so it sinks in better.” Purcell states that this does not suggest laziness on the part of the faculty, because it is in fact much easier to simply provide the information and placate the student. As part of PBL sessions the faculty encourage the cooperative
learning technique (Johnson et al., 1991, p. 3:12) of small-group processing, with the students giving feedback to each other regarding “whether they are getting what they think they should get.” Purcell says that the faculty “has the very difficult role of sitting there and not telling them what’s right.” Kennedy feels that it is more work for faculty to encourage students to organize questions, seek data, analyze data, and then propose and implement solutions. She says that they break up the class into small groups with three to four facilitators and that this is a “big drain” on the faculty’s time. “But it is worth it,” Kennedy says. According to her, every year the faculty ask the question “is it worth the effort?” It takes far more skill to say, “No, for your own good, you need to do these things.” It means that the faculty must repeatedly explain that students are responsible for obtaining information. Purcell said the faculty always encourage the students. The use of the term “encouragement” reflects a faculty attitude that does not communicate a demeaning, superior, or patronizing attitude. Though the faculty members require students to function in a way that is new, students are not abandoned to the task; rather the faculty encourage and support them.

The faculty are determined to give the students exercises and assignments that require them to analyze, apply, and synthesize answers to the types of challenges that are typical of respiratory care practice.

Discourse

Students learn better when they can teach the information. If all that you do in class is test recall knowledge, then people come to believe that the person who has memorized a lot of facts is the one who is smart. Walker puts it this way:

Our students know things we don’t know but if you just sit them in a classroom and you don’t interact with them and they don't interact with each other, everyone sizes up
each other, he is a dummy, he is a whiz and usually the kid that knows all the facts everyone just assumes is the whiz.

According to Walker, these people may not be the best clinicians because they may not know how to interact well with others. These students need to have their facts challenged and learn through a give-and-take process with other students and faculty. Other students may demonstrate other abilities in the clinical setting that are just as valuable:

The reality of it is that it is not just facts that you know, it is interaction with people, how you communicate in writing, speaking, how you listen, how you size up a problem, a situation, so our educational system needs to incorporate all the important qualities, and respiratory care has acknowledged that for a long time because we have the cognitive, psychomotor and we had the sense to include the affective domain.

Educational strategies and assignments that are likely to generate discourse or “academic controversy” in cooperative learning (Johnson et al., 1991, p. 7:1) are regarded as essential by all faculty. Discourse is a special kind of communication between individuals who have different perspectives. Discourse is not a debate in which participants seek to win, it is rather a win-win dialectic in which participating members seek to find and improve understanding. The reason that students must learn to discourse is because this type of communication between clinicians will help to identify and prevent the erroneous treatment of patients. Part of what faculty do to generate discourse is to picture complex scenarios, the types of unstructured problems that are found in real life. Another approach is to require students to participate in peer review activities that are bound to uncover differences in belief and knowledge. Additionally, students make presentations to each other and to asthma camp students. Frequently students must answer unexpected questions when making presentations, and this gives the student practice in answering the kinds of unexpected questions that arise in the hospital.
Several faculty said that students have to learn to communicate with physicians. Clark said this “would be very big” for the profession. Yates says, “They’ve got to discourse with doctors.” He continued, “They really have to know the subject inside and out.” He went on to contrast knowledge of the subject inside and out with just “being able to do the right thing.” When Walker describes their program training, she says, “Students interact with physicians and not just in the cliché way that CoARC requires physician interaction. Students have to speak at the bedside.” She went on to say that they have strong physician support to the extent that the physicians know what the students need to know and “they take the time to ask the questions to make all those novices think of how you go about showing what you know in a professional [manner].” Moore also speaks of the necessity to prepare students to communicate with physicians. “We have to be able to speak physiology to the physicians because that is what they want.” This goal was given as a rationale for having the students be able to support their positions with appropriate research and journal articles and being able to reference physiological interactions. Kennedy says, “They have to find an article that will support” the recommendations you make to “the physician.” Preparing students to effectively communicate with physicians is an important goal shared by all faculty.

Students need to be able to articulate the rationale for their recommendations and know the information well. Walker says, “The students are required to give presentations, to participate in debates where they argue for and against.” An even higher goal was that students need to learn to disagree with someone and still be liked. According to Walker, “people need to really learn to be effective professionals in how to disagree with someone and still be liked and still have teamwork and rapport.”
Co-Peer Teaching

Consistent with the Cooperative learning technique of co-peer teaching (Millis & Cottell, 1998) Purcell said that the best way to learn is to teach; “Oh, that’s the best way to learn something is to teach it.” Because of these goals the students are required to write and give presentations. The program faculty are purposeful in requiring the students to teach, present, and communicate as a means of helping them to learn.

Students do a lot of presentations and the program focuses on presentation skills. Teaching is believed to be one of the best ways to learn, and students are given opportunities to practice being teachers. Students are said to be given loose guidelines on how to structure presentations. Initially they may do poorly but through seeing other students’ presentations and participation in critiquing, they improve. They begin presenting in small groups in the PBL sessions the very first semester. They also present a research article and research projects in the research class. They put together a panel discussion on Acute Respiratory Distress Syndrome (ARDS), and they participate in debates where they argue for and against. Purcell felt that his test reviews were one of the best methods whereby students developed critical thinking. In the test review the students had an opportunity to argue for and against their answer or the nature of a test question. He views the test review as so valuable that he was very much disposed to provide students with points for a good argument even if the answer was not entirely correct. The reason given was that he wanted to encourage this ability and desire to interact in the search for knowledge. As previously mentioned, Grover described an additional assignment, where the students organized the asthma camp:
Juniors are going . . . We are requiring them to prepare for asthma camp and it is their responsibility to prepare all the activities for five days. We are just going to be there to oversee it, just one or two faculty.

For the asthma camp, the students must develop the curriculum, come up with the games, and act as camp counselors. The students do not have to present at national meetings or to physicians, however. The contexts of the presentations are kept low-key so that the students are not overly stressed, but they are all evaluated.

**Participating in Peer Evaluations**

Cooperative learning (Johnson et al., 1991, p. 2:7; Kagan, 1992, p. 19:7) stresses the importance of peer evaluation or feedback. Students evaluate each other in the research class, and the faculty take these peer evaluations into consideration when calculating a student’s grade. Purcell will not allow the peer evaluations to lower a students’ grade, only improve it. Students are given a Likert scale to use in peer evaluations. Moore talks about the importance of students learning to take responsibility for someone else’s work:

Why not start early with the students to start finding ways to make them understand that it is better for them to get a B on a project, then it is to hurt somebody because they aren’t holding their peers accountable, because they are not taking responsibility for something that somebody else might have done. That, to me, is the highest order of what our patients, our customers, need to get from us.

Faculty required that students do an honest peer review, as opposed to one that glosses over the performance and reports that everything the student did was good. Moore shares how he accomplishes this with students who are uncomfortable with the process:

After one team assignment, I had a student come to me and protest the fact that they/he got a C. He got the same grade as his partner. I asked ‘Well why do you think you shouldn’t have got that grade?’ Well because I did all the work and I did this and all they did was . . . ’
Moore responded to this student by observing “Oh, well, ok, you did an evaluation on your partner.” Moore pointed out that the student had given his teammate a strong evaluation. “Which one is accurate—what you are telling me now, or the fact that you put on this paper that you shared all the work equally?” The student confessed that he hadn’t wanted to give negative feedback. Because accurate feedback is so important in clinical care, Moore continually pushes his students toward honesty, “You have to call it the way it is. You are going to be interacting with doctors; you are going to be held to your word. And, so I am holding you to your statement here.” The peer review process offers a lot of advantages in respiratory care education, but honest, effective peer review is not a learning activity that students come prepared for. For peer review to be effective, the faculty believe it necessary to continually clarify expectations.

**Answering Questions**

Questioning by faculty that will make the students think is considered by Yates, Purcell, and Walker to be one of the primary ways in which students are taught to think critically. Yates said, “To talk is number one and the biggest thing in my mind that you can do is to quiz, to get people to talk, and to get people to think.” Many instructors spoke of the value of faculty questions. According to Purcell, “I like to ask ambiguous questions.” “I like to ask questions that there is no real good answer to.” With his questions, there is often “no wrong answer.” To answer these kinds of questions the students largely need to be able to show that they think about what they are doing. Purcell believes that it is helpful for students to argue in favor of the answer they chose during a test review: “I will give the students the opportunity to argue any question except for ‘I’ve got to get credit for it.’” It is viewed as helpful that the student may have the
question marked wrong so that afterwards, during the test review, they will argue for the answer they selected. Purcell maintains that they all do a lot of asking, “So what does that mean?” and, “So what?” When students ask a question, the faculty will refrain from giving a concrete answer, saying instead “That’s a good question, what do you think?” The faculty deliberately write exam questions that have to be read carefully, requiring the students to pay attention and think. Students will not always read these carefully, and then Purcell will make the point to them that this is a crucial part of their training: They have to read doctors’ orders carefully. Initially, this explanation might upset the students, but later they recognize that they are not reading the questions carefully and they will take the advice to heart. In class, faculty will call on students to see if they are paying attention. Dr. Purcell refers to a student to provide a current example, “There have been a number of times when she has been disengaged, checking her fingernails while he lectured.” Sometimes he ignores the behavior, but other times he uses it as an opportunity to call on the student and ask them a question. He has also called people aside after class and said, “You don’t look very interested in what I am doing. When I look at you, you appear to be looking around and paying no attention. Is that accurate?” Rather than coming across as accusatory or judgmental, Purcell tries to phrase his questions so that students can clarify whether his perception is correct or not. He voices his own limitations by saying “Sometimes I am better at that than others.”

It takes a while for faculty to learn what kinds of questions to ask. When students make a discussion post faculty will ask them, “Where did you get that?” Additionally, the faculty use questions to help students prepare for their credentialing examinations. When faculty provide clinical instruction they constantly ask questions that tie what is
happening in clinical to what has been presented in the didactic curriculum. Oral quizzes are considered to be number one, and therefore small-group interaction is necessary. Students have to tell how and why something is the way that it is. The faculty believe that they have to ask questions from every angle in order to ensure that students understand the material thoroughly and have the ability to apply their knowledge in a clinical setting.

Faculty believe that it is active discourse, more than anything else, that develops the abilities to critically think and communicate with others while learning the facts. The faculty use problem-based learning in which the students develop an evidence-based medicine and a whole-body approach for understanding and communication. Problem-based learning is a strategy that originated in medicine. Students are closely guided by faculty members to determine their own learning issues, which are the questions the students want to find the answers to. The students then conduct their own research to address these learning issues, share findings, and identify new learning issues. Evidence-based medicine is the current practice of identifying the level of research supporting medical practice. The whole-body approach is the practice of describing the physiologic interactions resulting from one or more interventions. Integrated with the problem-based learning approach are the requirements that the student verbally communicate findings and enter into discourse with other students and faculty as their assumptions are questioned.

Problem-Based Learning (PBL)

Problem-based learning is a learning strategy that breaks a class up into small groups and uses a patient case or scenario, the features of which are progressively disclosed to stimulate the identification of learning issues. Each group has a faculty who
facilitates group processes and provides the patient data. Group members identify learning issues and assign responsibilities for research to group members. Individuals research the questions at home and come back to the group to make presentations on what they learned. Group members question each other and rate each other’s contributions.

The use of PBL is a program decision that is reviewed every year. It is recognized as very expensive because a number of faculty are required for each class meeting, it is time consuming, and not an efficient teaching model. Walker says, “We have to question, can we really keep doing x, y and z?”

New faculty learn the PBL model when they come because it is part of the program’s educational philosophy. One faculty felt that PBL worked better with a bachelor of science program because the students needed to be prepared and motivated to think a problem through. McFarland says that “they need to be at a place where they desire to think through a problem.”

One faculty member said that students receive very little guidance. This statement needs to be balanced with an understanding of the amount of faculty support students receive. According to Kennedy, the whole class is broken up into three or four small groups. Each small group is assigned a facilitator, requiring three or four faculty to be present at each class. While this is a big drain on the faculty’s time, it is viewed as “worth it” because the method is considered to produce better learning outcomes. Students have high levels of faculty support but they are given less guidance than they are used to receiving. Students are actually characterized as hating the problem-based learning class until after they graduate, when they recommend it. In Beachey’s (2004) dissertation, one
of the only findings that differentiated outcomes of PBL programs was that graduates felt the instruction was more “humane,” probably meaning more personal or humanistic. Ceconi et al. (2008, p. 60-62) demonstrated positive correlations between credentialing examination scores and the implementation of a PBL program. Students are also characterized as disliking the online version of the class because it is a lot of work. A good example of these students’ feelings is represented by a student who later became a faculty member. Clark said, “As students, we felt like we are paying for the faculty to teach us, not just to tell” us what to read and for us to teach ourselves, “but looking back, it was a good method. I really did retain that information more than from a general lecture.” Clark remembers reflecting as a working therapist that PBL really seemed to work.

According to McFarland, students initially do not know what critical-thinking is, and they do not understand that they are not already thinking critically, “even when you tell them and you show them examples.” When students are divided into small groups there is an advantageous faculty-to-student ratio. Students are given a scenario and then they are told to identify what they do not know about it and what they need to know to be able to understand it better. Then they are required to go out and get the information, bring it back, and present it. They decide what is important to share. The students must evaluate the credibility of the sources in harmony with standards of evidence-based medicine. McFarland says that students are supposed to teach as an integral part of problem-based learning, “so if they really want to learn it, they have to be able to teach the class.”
Subsequently students are required to give each other feedback. Purcell adds, “We encourage the students to give feedback to each other” and this is done so that the presenters know whether they are presenting what they should. Even in the hospital, clinical instructors use the approach of not telling the student the next step. Here Clark asks them, “What do you think you should do next?”

The faculty believe PBL is a good introduction to the world. The program understands PBL as producing students who are better at the things they are required to do in the workplace, creating better patient outcomes. But the connection between PBL and better patient outcomes is not something that researchers have found a way to measure. Walker pointed this out by saying that the best studies say they “do no worse” on academic measures. But she says that they are better at those things that involved the everyday workplace. I believe today, Walker would cite Ceconi et al. (2008) as evidence that improved outcomes may be expected when PBL is implemented correctly. She said that “it is the things in the everyday workplace that” make a difference in patients’ outcomes. And she continues by recognizing that “we still are not very good at measuring” how the everyday interactions between the caregiver and the patient affects outcomes. Roles are emphasized by all faculty. The students’ job is to learn the information and not blame the faculty if they do not learn. The faculty’s job is to present information in an intelligent fashion. If it is not understandable to the student, it is the student’s job to tell the faculty this is the case.

PBL is recognized as an expensive learning strategy currently without clearly demonstrated patient-outcome advantages. Faculty still believe that it is an important method of establishing the students’ ability to communicate, find information
autonomously, and think critically. Studies published recently in respiratory care
demonstrate an advantage in credentialing exam performance.

Evidence-Based Practice and the Whole-Body Approach

Two individual faculty members reported two systems which they characterized
as the primary method of developing critical-thinking. These systems are used and
introduced in the PBL course and then used throughout the remainder of the program.
These systems are evidence-based practice and the whole-body approach. Grover asserts,
“I think we emphasize more than anything evidence-based practice.”

Evidence-based practice and evidence-based medicine is a system whereby the
methods used to treat patients in the hospital are established on research. This is
important to respiratory care because the therapists need to be able to justify decisions
regarding patient care through research literature. Kennedy said, “They have to find an
article that will support what you want to do with the physician.” When expert faculty say
that the program uses the evidence-based practice method of teaching critical-thinking,
they mean that students must be able to back up their positions and recommendations
with research, and that they are taught to evaluate the level of support reported by the
research. Here is how Grover puts it:

How do you read and compare? You look at the methodology, you look at the
empirical evidence that is out there and you ascertain whether it is credible or not. . . .
We keep bringing them back to, what evidence do you have to prove that? Is that a
credible source? . . . Was this acceptable to a peer-reviewed journal?

Evidence-based medicine or practice is one system that the program uses to help students
critically evaluate the credibility of a position.
The whole-body approach does not exclude or compete with evidence-based medicine. It is a complementary system that Leigh said was a primary method used to teach critical-thinking. The ability to speak about the effects of one intervention on the other parts of the body based upon established physiologic relationships is what Leigh is speaking of when she says “the whole-body approach.” For instance, the initiation of positive pressure mechanical ventilation increases the mean intrathoracic pressure, which impedes venous return. This reduction in venous return results in a drop in cardiac output that further results in a reduction in blood pressure and subsequently urine output. A drop in urine output results in other physiologic changes and homeostatic adaptations. A familiarity with these homeostatic interrelationships across the lungs, the heart, the brain, the kidneys, and other organs forms a physiologic basis for counterbalancing therapies. As with evidence-based practice, this is a method of presenting the basis of one’s beliefs and recommendations in a way that is familiar to and consistent with the language of physicians and others who practice health care.

Reflection

Students are introduced to the idea of reflection at the very beginning of the program during the PBL course. Purcell says, “One of the big things that we talk about is reflection.” Students are told to think analytically about what they are doing and develop the ability to communicate why it is right or wrong. Mistakes are acceptable, but part of the reflective process is to ensure that students do not repeat the same mistakes. Reflection is not taught using an overt process that is talked about, instead assignments are given that induce reflection. Students are encouraged to reflect in the process of taking departmental comprehensive examinations, where they are not told what answers
they get correct or incorrect. Reflection is part of the midterm and final clinical examinations. Kennedy described what occurs in clinical: “We have to do an evaluation of the clinical performance at the end of the clinic. And, you know, that is a way for them to reflect, and I think that's one of the major tools.” Clark gave another example of reflection in clinical, “I try to say . . . ‘ok, today you saw active abdominal expiration,’ and I will try to have them write down the one thing that they learned.” In contrast, Grover said that the rigor of the program resulted in not having “as much time for reflection.” The concern is that when students and teachers have too many tasks to perform or too many topics to cover, there is insufficient time for putting it all together. If a faculty member does not also teach in the clinical area, reflection is thought to be hampered. Reflection is considered to be a large and important part of learning, and the general view is that there could be more reflection built into the curriculum than there currently is. Walker noted, “I use it [reflection] in almost everything I do.” Faculty are intent on creating room for reflection by the students because critical-thinking often requires time. It may require a significant amount of time when a student first thinks through important physiologic relationships. As students move from novice to advanced beginner they will be able to recognize relationships more rapidly, but at first it is time-consuming and requires patience. For students who are mainly used to memorizing facts it can be hard work to think critically and to see how the facts are interrelated, so time for reflection is important.

Writing and speaking provide reflective opportunities for students to learn to think critically (Van Horn, 2000, p. 130). Faculty also view writing as a practical method that students can use to gain recognition in the profession. Students write a paper early in
the program on a subject of their choice, and write about learning issues as part of the online PBL class, and they must support their positions with references. Walker says:

All of our students should be doing this [writing a paper] and early in their career, and we just changed the curriculum to where the students do that and then we encouraged them to take those papers and apply for scholarships.

Many staff therapists are said to be deficient in writing, and the program therefore has an interest in producing graduates with more skill in this area. The program’s students have won several awards, indicating that writing is being well taught. Walker says, “A lot of staff therapists have good questions and do good work, which solve problems, but they tend to be anecdotal and it’s the writing piece that is missing and [using] a studied approach.” Writing assignments should be appropriate to the level of student. For instance, it cannot be expected of freshmen to write as well as bachelor of science degree students, but they should still have papers to write. Writing enables students to take more time to examine their own thoughts. When students write, the thought is more permanent and it can be analyzed carefully. It is easier after writing to identify weak or incomplete thoughts. Sharing writing with others can help students to see when they need to rephrase an idea. Students retain by doing and something that students can do is to write.

The faculty are determined to give the students exercises and assignments that require them to analyze, apply, and synthesize answers to the types of challenges that are typical of respiratory care practice.

**Program Components That Develop Critical Thinking**

The expert faculty emphasized the importance of various program components in supporting the development of critical thinking. The faculty actually saw a link between the prerequisites required in the program and other similar program components and the
ultimate objective of eventually developing critical thinkers. When asked about the teaching of critical thinking, they spoke broadly about this prerequisite education, student selection, orientation, numbers of faculty, program improvement, and how clinical education is provided. In this way the faculty could think of the program holistically like they thought of the human body as many different organs that are interdependent and important to the functioning of the whole.

Prerequisite Education and Student Selection

Faculty were unified regarding the importance of prerequisite education and careful student selection, but Walker articulated this best during the interviews when she said:

What works really well is to set prerequisite courses and I believe a minimum of four [college] courses [is needed]. More if you can negotiate it through the system that you are in. Students have to have the fundamentals of English 101, Algebra, Basic Science, Physical Science even.

The faculty voiced concern about an open access style of education attributed to technical colleges offering associate degrees. At the same time they said that the bachelor of science program of which they were a part was fortunate in that their students had already completed 2 full years of education before they qualified for matriculation. Walker said, “We have the ones who have already successfully passed all those introductory courses.” Even with the program prerequisites strictly enforced, some students were significantly challenged by the critical-thinking challenges inherent in good respiratory care education.

Several faculty have found that students are not as prepared as they had hoped. Yates observed that even “students with so-called good grades that come in here” are not good thinkers. McFarland also complained that many students
don't even know that they are not thinking critically. They do not realize that they are not thinking critically, even when you tell them and you show them examples. It takes them time, too, to actually speak with critical thinking concepts. Where they come to realize, ‘Oh, this is what critical thinking is about!’ they have not been groomed for critical thinking in their preparation.

Purcell spoke with apparent envy, saying the situation would be better if they had students who had completed the premed program at college: “I wish we had those medical student rejects from the university but we don’t.” Faculty also complained about grade inflation, even students with high grades who had completed 2 years of college prior to entering the program still had trouble with the levels of learning required. Walker said:

Students come to us today that have A averages and are juniors in college, but they are weak in their basics, especially algebra and math abilities. And you wonder how did they earn these grades? So there is, I think, degree creep and grade creep.

The importance of prerequisite education and grades has been underscored by publications in respiratory care (Ari, Goodfellow, & Gardenhire, 2008) that demonstrated the strongest predictors of student scores on the CRT and the WRRT as science grade point average and cumulative grade point average. In another recent study, Andrews, Byington, Masini, Keene, and Burker (2008, p. 50) suspect that “a limited or unrealistic expectation of the demands of a respiratory therapy program may be one of the largest contributors to attrition.” Faculty recognize the possibility that students could enter the program and be unsuited for it. Walker asserted, “The sooner you can” help them “find some other career path” the better, but do not let “them just flounder.” Faculty recognize that many students still enter the program inadequately prepared and are eager to begin a process of orientation where student expectations are aligned with program realities.
Orientation

When an educational program uses methods that the students are unaccustomed to, it is very important that the students are told what to expect and why these methods are used as stated in a recent study (Andrews et al., 2008, p. 50), “A limited or unrealistic expectation of the demands of a respiratory therapy program may be one of the largest contributors to attrition.” This is the case for orientation. In this program students are required to determine what they need to learn and then find their own information and teach it to another student, while being subjected to peer review, rigorous standards, and faculty who will often not answer questions. Such a learning environment could be a shocking experience. Purcell described the instructional process this way:

The students are given a scenario and they discuss the scenario and then they are to identify what they don’t know about it and what they need to know to be able to understand it better and then they are required to go on out and get information then they come back and present the info and they decide what’s important to tell the students. And then we encourage the students to give feedback to each other whether they are getting what they think they should get. And the faculty then has the very difficult role of sitting there and not telling them what’s right.

This is not a process that many students have previously experienced. McFarland says:

You know, our students come in with two years of college. You would expect juniors in college to have the ability to work independently and think through a problem . . . but their thought process is really low, and so you wonder, they were going through school where nobody ever challenged them.

If most students have not been previously challenged, the shock of this new approach could result in discouragement, frustration, and anger, which may not promote learning. Moore points out that the discouragement is usually temporary. “Once they get over it, and once they get over the frustration they come to like the process.” Moore told of a student who exemplified the need for orientation:
One of the guys got so mad at me. He was a big burly guy. When we interviewed him, he had already been up at 4:30 in the morning moving cows. Anyway, he was a bright guy and he was not used to getting told ‘no.’ One day I said to him, ‘I am sorry but you are wrong.’ He got all red and said ‘Well I don’t understand.’ I said, ‘Well, you can either ask me a question or you can go and read the material again. You have got to learn it. You have to get it right.’ There are those people who need a lot of orientation and resetting of expectations.

Because of the nature of the instructional practices, the faculty recognize the importance of an excellent orientation.

Students are told from the beginning of the application process that this program uses different educational strategies than they might be used to. They are warned that this will be the hardest program that they have ever been in (Glasser, 1998, p. 100), and that they will not be able to memorize information and then dump it. When the students enter the very first quarter of the program they are started in a PBL course that introduces them to the philosophy that follows in every course thereafter. Clark described the approach: “Rather than being handed the information, the students must read and discuss, so it sinks in better. You know when you have to kind of figure out a lot yourself.” Because this is the understanding of the program, when students ask an instructor a question, the instructors are likely to ask a question in reply, which the student will then have to answer. Moore says:

We force students to question one another. When someone questions you, they may get a little attitude, and you can’t escape them. So, if you get aggravated or frustrated by someone, work it out. So I start talking about that right away.

The students come to understand that the faculty are not trying to deprecate them, but that they fully believe that this intellectual work is required to prepare students to be who they want to be. In the words of Moore:

There is a camaraderie that the students develop with us, too. We are going to work them hard, we are going to test them and we are going to be hard and they are going
to earn every grade that they get because we care about them and we want them to be successful.

An orientation is thus invaluable when a program plans to initiate any rigorous educational practice. It is even more essential when the practice is out of a student’s prior experiences.

Faculty-to-Student Ratio

Faculty believe that for discussions to be effective, they must be the ones asking questions of the students, and this necessitates a good faculty-to-student ratio, where at times there is a low number of students interacting with each faculty member. Blevins said, "I see it in the clinical area. The nice thing is there I am sitting there one on one.” Effective student-to-student interaction and peer review do not happen on their own, and faculty are needed to solve the natural challenges that arise from these approaches. Yates said, “I make down-time, so I can teach. Including lunch is waiting for us or a snack or whatever we're bringing just to have that small group. One-on-one type contact . . ., I think, is a really strong element.” Advantageous faculty-to-student ratios are necessary as a means of supplying external motivation and appropriate structure.

A good student-faculty ratio is necessary to keep students adequately supervised in clinical. Purcell said we “are limited in the number of students we could take in our clinical facilities because we do keep them under arm.” Purcell describes how the clinical is adjusted to provide the appropriate amount of supervision to students:

You've got to give each student a little block here and a little block here and a little block there. And so we have to purposefully hold them back and only give them one or two patients per student.
Initially, students in clinical are said to need frequent blocks of time with the clinical instructor. Faculty do not see how a program could provide adequate instruction to students with only two full-time faculty members. Yates said:

To put a lot of attention to a small number of students, and so you need a lot of faculty to do that, because what you are doing is showing what integration is all about, and you cannot do that in a classroom with multiple choice tests. With, you know, 20 or 30 whatever the larger the number of students, the less one-on-one you give your students, and the more intimidated your students are to actually engage in conversation, and be critiqued and be quizzed, and it is a one-on-one type thing or small-group-type thing.

He added, to “teach people to be masters of something, you need a master in a small group or one-on-one.” The expert faculty in this program are adamant about having a small number of students in contact with faculty and in some cases even one-on-one instruction.

Faculty Perspectives on Curriculum

Purcell maintains that some topics are important enough for students to “get over and over and over again” rather than just once. Courses are sequential with knowledge building incrementally and always based on previous learning. Purcell says: “Every class we have is a prerequisite for every other class.” The curriculum is revised frequently. The program will keep working on the organization until it is satisfactory. According to Purcell, the faculty spend a lot of time in informal discussions, “We do sit down and try to figure out what our curriculum does; we spend a lot of time in informal discussion, picking each other’s brains.” Faculty retreats are scheduled for this purpose. Sometimes a faculty member will discover an important activity that would make a large difference in student learning, and that activity can then become a major part of the program. For instance, Walker was assisting a student in writing a paper for a scholarship. She received
no workload credit and the student received no credit for this activity. The faculty saw that this could be of benefit to all students, and the program curriculum was rearranged to give all students the opportunity to write a research paper. The curriculum includes deadlines to ensure that students turn work in on time. An online course alternates more difficult assignments with a chat assignment, in order to give the faculty an opportunity to catch up. The curriculum is arranged with external incentives so that students will participate at the appropriate level. A significant amount of time is allocated to clinical practice. Overall, curricular structure is purpose driven and dynamically modified in response to thoughtful and collaborative faculty assessments.

Quality Clinical Education

All faculty expressed the value of clinical education in the development of critical-thinking. Purcell said:

I think that that’s one place where critical thinking really can be because there’s never a clear answer in the clinic. You’ve always got this really general nonspecific problem and they need to collect the data, evaluate it, and come up with a plan.

The faculty had much to say about the way clinical education should be provided. Kennedy noted, “It is because I am actually in the clinic so I am able to see where they are actually being able to put the pieces together.” McFarland noted, “We take these things and move them into clinic, and that is one of the things that from my standpoint directly improves clinical care.” As a whole, the faculty felt that much of the clinical instruction provided across the nation could be improved. There was a worry that too much of the current clinical instruction provided by other programs is not beneficial, as students are often simply assigned to undermotivated clinical staff with no training in education, because these programs do not have the money to pay for clinical instruction.
Purcell said, “Because if you get a good clinical instructor he can make things come alive. If you get a bad one the students just get shut down.” In contrast to using unpaid and poorly trained clinical preceptors as is practiced in other programs, Purcell described the clinical program that they built:

But when you are talking about respiratory care procedures in the intensive care unit we want to make sure that the faculty that know what is going on in the classroom are also doing some stuff in the clinical, so that they know where to go with them, and what the level of development of the students is, and their job is to teach the students as opposed to performing patient care.

The optimal clinical program is what McFarland called “integrated instruction,” where classroom and laboratory instruction is studied and practiced prior to clinical practice. Prior to entry into clinical practice, students are given activities that develop abilities in research, thinking, and communication. The initial clinical supervision and instruction is then provided by the same instructors who have been working with the students in the laboratory and classroom. Moore said, “I think our faculty-led clinics are a huge part of our success.” This way, instructors know what the students have been exposed to and are aware of their strengths and weaknesses. Moore said, “I think one of the major benefits of having our faculty with the students in their initial clinics is that the clinical faculty are emphasizing assessment.” These instructors are able to ask questions in the clinical setting that help students associate what they observe with what they have already studied. Grover said, “I have the luxury of being both the clinical instructors and one of their teachers. I know what is going on in the academic areas as well as what’s going on in clinical.” The instructors are already acquainted with the students and are highly motivated to see them succeed. Faculty contrasted this picture with that of a student arriving at clinical and being assigned to a poorly motivated clinician who doesn’t
particularly want to teach and who has less than optimal demeanor toward the respiratory care discipline. Many of the seasoned faculty reiterated the importance of using didactic faculty for the initial instruction in the hospital. Quality clinical instruction builds critical thinking.

To ensure optimal clinical instruction, a preceptor training program has been developed, and only clinicians who have completed this instruction are allowed to supervise students. Student and preceptor clinical schedules are developed by the Director of Clinical Education. Paid clinical faculty may have as many as five students. The clinical faculty collaborates with the hospital charge personnel so that the patient load is appropriate to the level and number of students. The faculty member ensures that the students have adequate time to research and discuss appropriate questions. In harmony with the concept of situated cognition, it is this verbal questioning in the context of real clinical challenges that the faculty develops critical thinking. Verbal questioning with advantageous faculty-to-student ratios is the most important part. Yates rhetorically asks how these methods could not be effective:

I don’t think there is any chance of them not working. I guess that’s the reason, because they basically have to come up with, you know, ‘why’ and how things work. So how are they not going to work?

The value of student-faculty questioning is one of the reasons that the program makes arrangements to have didactic faculty also teach in the hospitals. This type of teaching would normally be expensive for the University, but it has developed an arrangement with local hospitals to provide contract patient care.

Under this arrangement the hospital pays the University for patient care and the University uses this pay to contract the clinical faculty. This allows the University to
cover the expense of instruction with a faculty-student ratio as low as four or five students per faculty member.

Preparing for Graduation

From the beginning, the program focuses on preparing students for graduation and their entrance into the clinical world. This is why students are taught to identify their own learning issues and why they are given practice in communicating, writing, and arguing for and against particular practice or points of view while maintaining rapport with colleagues. This is also why students are given practice in preparing for credentialing examinations, are required to conduct an asthma camp, and are provided with so much quality education.

Preparing for Credentialing Examinations

Faculty take the preparation for the national credentialing examinations very seriously. Kennedy sees examination preparation as connected to critical thinking and finds it interesting that respiratory care is a profession that actually “measures critical thinking on the examinations.” The program employs a different set of instructional methods designed to assure examination success. This set includes the “departmental comprehensive examination” (DCE). These examinations have questions modeled after actual multiple-choice credentialing examinations, and are part of a larger constellation of curricular components designed to assure credentialing success.

Purcell said that the program faculty study the exam matrix to make sure that each item is covered. “In the last three months we’ve been asking everybody to go through and identify what parts of the RRT matrix are . . . and we are identifying which classes these topics are covered in.” The program uses clinical simulations and has hired a faculty
member who is employed by Kettering National Seminars, an organization that offers nationwide review courses for examination preparation. Kennedy said, “We have faculty on board and she works for Kettering.” Students are tested on the material of the previous term in the subsequent semester, and then they take a DCE which is, according to Grover, “basically the big final exam for the entire semester.” According to Purcell, students are able to take credentialing-type examinations repeatedly online at home until they achieve the required score. “They have unlimited time to do it. They can take it 100 times.” The online examinations, which are not proctored, can be taken over an unlimited amount of time within a certain period. The student must pass the Written Registered Respiratory Therapist (WRRT) Self Assessment Examination (SAE) to graduate. Students are not required to pass the clinical simulation SAE examination because, according to Purcell, until they finish their clinical they really don’t know enough “to do a clinical simulation examination.”

The faculty use external rewards and sanctions to make sure that students master information at an appropriate time in the curriculum. According to Purcell, they don't allow the students to take the Certified Respiratory Therapist (CRT) examination halfway through clinical. “We aren’t playing that game. So it’s a carrot to get them moving along or sort of punch for a wayward child.” Students are not told what the answers are for the departmental comprehensive examinations, which they can retake. Instead, they are told to look up the information. The comprehensive examination questions are organized by categories that correlate with program classes. Kennedy said that “the test scores are good” and that these scores reflect the effectiveness of their learning and teaching strategies.
Program Assessment

The program faculty talk to students, graduates, and employers. Kennedy said, “The employers want our students.” The faculty members characterize program graduates as largely convinced of the effectiveness of program methods such as PBL. Beachy (2004, p. 96) reports that “consistent with the medical education literature, . . . graduates of PBL programs are generally more satisfied with their preparation than are traditional graduates.” The program has an excellent reputation across the country, as evidenced by the recommendations made by the committee on accreditation for respiratory care to consider this program for research. If student feedback on clinical rotations is poor, the program will stop using a clinical site. Purcell said, “Students come back and give us feedback on the rotations. . . . And they are usually pretty honest about it.” The faculty meet to evaluate the program and faculty performance is formally evaluated as well. These sessions are used to ponder how individual instructors can become more effective. Kennedy spoke about this extensively, “We meet, we analyze every year.” She said that the faculty are always asking, “How can I make it better.” The clinical area is improved the same way. Then faculty receive feedback from seniors prior to graduation. Kennedy gave an example:

We have changed the program based on student suggestions. In fact, we changed due to student concerns regarding gross anatomy. ‘Well you know this gross anatomy that we're taking. We really don’t understand why we need to know the butt muscles’ because the gross anatomy class does the whole body. And it was tough. And after a number of classes said this we re-evaluated this and asked, ‘Do we need them to do this whole body for gross anatomy?’ We think we can fix that to where they would be doing the cadaver for [primarily the] respiratory [system]. So we did that, and they [the students] have been much happier.

McFarland spoke of the faculty’s attitude toward improvement:
I think it was a natural migration from analyzing--if you are analyzing every semester every year what works, what doesn't work. First you have the focus that you want to go there, you have to adopt a philosophy that critical thinking is important. You have to adopt a philosophy that you want to make a mission, that you want to have mission objectives toward improving critical thinking.

The above are examples of how the faculty apply a “studied approach” to programmatic improvement. The program administrators systematically evaluate their experience, student evaluations, and program outcomes to adjust the curriculum and instructional methods. Unless those in charge pay attention to how learning is influenced by practice and how the curriculum works, the program cannot continue to improve.

Constant evaluation and re-evaluation has been recommended for the reform of allied health program accreditation (Baker, 2002, p. 93). Every semester, what works and what does not work must be analyzed. The mission of the program must be kept in focus. If the mission is critical thinking, one must be willing to follow the methodology that will achieve this, and to change if necessary. It is important to have people with different backgrounds who think differently. Administrative support is necessary. Through the experience of participating in program improvement the faculty have developed opinions about certain elements that make a strong program.

According to Grover, one way to strengthen programs is for the profession to require master’s degrees of its educators. She said:

I am for making it a real profession that requires professional standards, that requires this level of professionalism. But I say you hire the proper educators. You know just because you have been a therapist for 20 some years and they are too unstable to walk the halls anymore doesn’t necessarily mean that they should be teaching.

Yates also focused on aspects of faculty when reflecting on his 22 years of instruction. His thinking was that the most important elements of instruction include a low number of students to each faculty member in clinical and “rather than farming” students out to
unpaid and undermotivated clinical staff, programs should use paid and motivated faculty to provide clinical instruction. This importance of respiratory therapy faculty has been underscored in research that establishes a relationship between the degrees held by faculty and the learning outcomes of allied health students (Ari, 2005, p. 66; Jarvis, 2006, p. 1). Ari (2007, p. 43) also showed a correlation to respiratory care WRRT examination performance and the program budgets for faculty and the number of Ph.D. faculty.

Change, even at this institution, has not always been easy. It is important that program directors or other people trying to effect change do not prejudge the reasons as to why others are not immediately following. They may not be resisting change so much as they are fearful of it. Walker also felt that leaders should ask the opinion of others and be mindful of their concerns. Often, however, leaders will not receive an immediate answer. The environment for change must be one of trust.

The leader should model critical thinking while seeking to institute change so that all realize that there is no shame in not having all the answers. In a trusting environment, people will take responsibility for their own performance and mistakes, and will not blame them on others. According to Walker, leaders should take responsibility, and not blame those under them, when a program is trying to change and something does not work out so well. However, if something works well, leaders must make sure that they commend their followers for the excellent execution. These types of stances help to cultivate an atmosphere that is trusting and conducive to improvement. Attitude cannot make up for poor logic or poor planning, but it is a crucial part of the formula for improvement.
Additionally, Walker proposes that programs use technology to share expertise and complement each other. The faculty member of one program could teach a class for another program and exchange could result in overall improvement.

**Summary**

There are certain underlying concepts that influence the teaching strategies faculty choose and the methods whereby the strategies are employed. The themes reflected in the faculty beliefs are: (a) The program must motivate students to “learn by doing” and to be responsible in order for critical thinking to develop; (b) there are many effective learning strategies to engage students in the development of critical thinking; and (c) critical thinking is not learned unless essential program characteristics exist.

Faculty recognize that when students graduate they must be able to recognize problems, formulate theories, collect data, propose solutions, and implement them all without the benefit of the program and the faculty. If students are to learn to take these complex actions, they must “learn by doing” and be responsible for their learning. Purcell provides an example of a question he poses to his students, “What makes sense to you? Because eventually, you are going to graduate and I’m not going to be here and you need to learn how to make your own decisions.” Faculty also believe that motivation is at least as important to the development of critical-thinking as the intellectual or cognitive aspects of professional development.

Faculty believe motivation stems from—at the very least—an interest and fascination with the subject. Interesting learning activities bolster student motivation. There is a place for external motivation. Program requirements are organized so that students have to do things that are stressful and that they would not otherwise choose to
do, but, once done, they are appreciated. While students need to learn by doing, the role of faculty is crucial as a means of supplying motivation and structure. To prepare students to be independently competent, the faculty try to provide them with experience in solving the same kinds of problems. Students must learn to communicate effectively through experience and the best way to learn is to teach. Critical thinking is best learned in the place that it will be exercised. This is contextualized knowledge.

The faculty have adopted many strategies that require students to learn to communicate by interacting in authentic contexts. The program uses PBL, assignments, and clinical instruction that require the students to write, present, and argue for and against and frequently answer verbal questions, both in the classroom and laboratory, and in the clinical setting.

The faculty believe that certain elements of the program are essential to the students’ learning of critical-thinking. In order for verbal exchanges to be effective, the faculty must at times be the ones asking questions of the students, and this necessitates an advantageous faculty-to-student ratio. Student-to-student interaction and peer review do not happen on their own, and the faculty are needed to solve the challenges that arise from these instructional approaches.
CHAPTER 5

ALTERNATIVE REPRESENTATIONS

Introduction

The challenge for this research is how to conceptualize the findings of the expert faculty in a way that will extend our understanding of critical-thinking pedagogy. Is there a way to create an economy of representation that helps make sense of the complex? Information is inadequately appreciated when interrelated findings are placed into lists without any representation of how they work together or how to understand them. Is there any coherent beauty in what we discover? Metaphors can suggest how findings are holistically related and become fertile ground for new understandings that open doors to scientific research for years to come (Danforth, 2007, p. 10). A metaphor could help to explain how certain mechanisms work or do not work in certain contexts (Beachey, 2004, p. 113). “Metaphorical comparisons are those that appeal to the imagination as well as to the intellect” (Bartel, 1983, p. 45). The unpredictable comparison of a metaphor in this study is used for the same reason that the faculty studied attempted to be entertaining to their students. Reading research findings can be monotonous, but an instructive metaphor can provide some emotional relief in order to stimulate memory and stimulate further interest (Bartel, 1983, p. 46). The novelty and applicability of this metaphor may serve to assist with the dissemination of research findings.
This chapter presents two interrelated alternative representations: a metaphor and a mathematical model. Metaphors are prominent in language. Common metaphors that go unnoticed (Phillips & McQuarrie, 2007, p. 137) are internalized and have the ability to affect our conceptions of what we know. They have the ability to heighten aspects that are similar and mask areas that are not similar in the comparisons (Phillips & McQuarrie, 2007, p. 138). Metaphors are more than instructive comparisons. Because of the originality of the comparison they have the ability to move people to action. With this power there is a danger that metaphors are not understood or are misunderstood (Bartel, 1983, p. 33). Some metaphors found in common vernacular can negatively shape people’s interpretation of events. “Writers looking for ways to counteract complacency turn frequently to bold metaphors to stimulate both thought and feeling” (Bartel, 1983, p. 47). The inclusion of metaphor is intended to positively invigorate a discussion on the subjects of education and provide a provocative model.

The proposition of an algebraic formula as a way to represent interrelationships is commonplace and provides an economy of representation. This study’s findings are presented using the placenta as a bold metaphor. This metaphor elaborates upon the language use in social learning theory in which the zone of proximal development (Vygotsky, 1978, p. 86) is said to define those functions that have not yet matured but are in the process of maturing as currently “in an embryonic state.” Flowing out of the metaphor of the placenta is the idea that the relationships governing the diffusion of oxygen have similarities to relationships expressed as social learning theory (Bandura, 1977). Social learning theory provides an explanation for learning in terms of a “continuous interaction between cognitive, behavioural, and environmental determinants
Social learning theory provides inspiration for the models used to represent the findings of this study. This study uses the formula expressing the relationships governing the diffusion of oxygen to arrange the findings on motivation, learn by doing, and the engagement of faculty and other resources. This is done for the same reasons that the placental metaphor is applied. There are similar relationships within educational dynamics to those observed in Fick’s law and this similarity is likely to result in some pleasure and motivation for respiratory care instructors who typically love physiology. The formulaic proposal found later is given to stimulate discourse among respiratory care educators. The relationships expressed are educational constructs or postulates designed to invigorate instructive deliberation. This formula helps to demonstrate how the three major findings of this study are aligned within the social learning theoretical framework of Albert Bandura.

**The Concepts to Be Modeled**

The main beliefs of the expert faculty that need to be vividly impressed upon the mind are that students learn by doing and that learning is dependent upon motivation. Students must be made responsible for their own learning. Faculty use a variety of activities to enhance critical thinking, but in order for this to be done effectively certain programmatic principles must be in place. There must be a closeness or intimate proximity between the learner and faculty support, between the student and other resources such as labs, computer technology, and scholarly writings. The success of an educational program depends upon the interrelationship of many factors in a complex way similar to a living system (Kline, Kuklis, & Zmuda, 2004). A respectful metaphor
(Herbers, 2007, p. 105) can offer insights as to how these factors might relate to one another.

**Metaphor**

The dynamics which influence learning at the interface of the faculty and students are proposed to have corollaries with many physiologic characteristics found in the interface between mother and baby at the placenta. The mother grows a dense network of capillaries in preparation for the fetus, and the newly arrived fetus enters this capillary bed by growing a corresponding dense network of finger-like projections called villi, as shown in Figure 1.

Figure 1. Diagram of secondary chorionic villi. Many small villi grow into the maternal capillaries providing a vast surface area to support the diffusion of oxygen into the fetal bloodstream. From *Anatomy of the Human Body*, by Henry Gray, 1918. Retrieved from http://en.wikipedia.org/wiki/Chorionic_villi
Early on in the relationship a large surface area exists in the zone of diffusion for the transfer of life, giving oxygen, sugar, protein, carbohydrates, antibodies, and other nutrients from the mother. The fetus is also able to transfer back to the mother the products of fetal life, carbon dioxide, urea, etc. The mother’s blood absorbs these imperfections and keeps replacing them with the building blocks of life. The mother does not build the fetus; the fetus must do that. But the mother provides the building blocks and continually removes the broken pieces. There are multiple complex factors that influence the exchange of nutrient and waste products, including the large surface area, the narrowness of the placental barrier, and the magnitude of the concentration differences across the placenta (Reik et al., 2003, p. 5). When the mother’s blood has far more oxygen than the fetal blood there is a larger diffusion of oxygen than when there is hardly any difference at all. The placenta uses active transport in addition to diffusion to transfer nutrients (Reik et al., 2003, p. 6). What is necessary in the zone of proximal development for the flow of information and knowledge in a respiratory care program can be thought of as similar to the factors governing the nutrient and gas exchange that must be transferred from the mother’s bloodstream across the placental barrier and into the fetus.

In an academically strong program there is an immense amount of work on the part of the program faculty, administration, and staff in preparation for learning. Laboratory equipment, computer equipment, internet technology, the acquisition and training of faculty, the construction of detailed lesson plans, the adoption of progressive learning strategies for the hospital and the classroom, an integrated curricula as well as securing laboratory and classroom space are all part of the preparation needed for
effective learning. Likewise, in an academically strong program, matriculated students are oriented to understand the crucial role which they have in constructing knowledge and skill. The students learn that the faculty and laboratory resources are available and organized for them but they have to take advantage and use the faculty, students, and laboratory equipment. In the zone of proximal development the students have to attend and spend significant time closely interacting with other students and faculty and the assignments for learning to occur. The more difficult the skills and concepts to be mastered, and the larger the barrier to learning, the greater the amount of time that must be spent on the activities of learning and the greater the need for motivational support.

Program learning is dependent upon the student’s sense that what is to be learned is relevant to them and their future as respiratory therapists. This sense is accentuated when the student puts knowledge to practical use. When the student applies knowledge in the hospital, in the laboratory, or in the children’s asthma camp, she understands the value of that knowledge and desires more. The faculty’s passion for the knowledge to be learned and close questioning and interaction with the students while showing excitement and joy at the students learning also impresses the student with the importance of the information that is studied.

For a program to provide the necessary engagement and student discourse, it is imperative that the program have faculty of high quality in terms of graduate education, technical expertise, and passion (Ari et al., 2003). A program must also have sufficient laboratory equipment and space, clinical facilities, classroom computers, and library resources.
In this metaphor the placenta is the place of learning, the interface between the student and the many resources including faculty; the womb is the respiratory care program and the university is the mother. See Figure 2.

Under ideal conditions and in certain ways the mother is glad that there is one or more babies within her. The mother takes care of herself, because she cares about the baby. She feels like a very important part of her purpose at that time is to provide what is needed to grow the baby. The relationship of the university to students can be like that of a mother to her unborn child. However, it is possible for the university administration to have many different ambitions, including the initiation of new programs, obtaining grants, and publishing research. These are all important when the objective in part is to provide good education in the current programs. If, on the other hand, the students are largely viewed for the tuition they generate in order for that tuition to be used to serve these other goals, there is something amiss. There is nothing wrong with research, grants, or new buildings as long as these do not become the mission at the expense of learning in the classroom. Two different institutions can be doing the exact same things—securing grants, publishing research, and building—but one of these two institutions can have the right mission priorities which help education in the classroom, and the next institution can have the wrong mission emphasis, which results in less than optimal learning in the classroom. This means that it is a very important aspect of leadership to keep the mission straight. The baby that is valued must continue to be learning in the classroom, and learning in the classroom is not only dependent upon the faculty and students, it is also dependent upon the resources of the university.

**Mathematical Model**

One way to portray the results of this study and show their alignment with the theoretical framework is with a mathematical representation. The metaphor of the placenta, the fetus, and the womb begins to broaden the conceptualization of the zone of
proximal development and lay a foundation for a mathematical model (Beachey, 2004, pp. 101-104; Charmaz, 2005, p. 507). This metaphor proposes that there are elements that govern learning which may be arranged mathematically in a way that correlates with the physiologic variables governing diffusion of gases or solutes in the placenta according to Fick’s law of diffusion (Reik et al., 2003; Sibley et al., 2004). What follows is Fick’s law of diffusion:

\[
\text{Diffusion of Oxygen} = \frac{\text{Surface Area} \times \text{Gas Solubility} \times (\text{difference in O}_2 \text{ pressures P}_1-\text{P}_2)}{\text{Barrier Thickness}}
\]

Here we see that the diffusion of oxygen is directly related to the surface area, the gas solubility, and the difference in partial pressures of oxygen across the placental membrane and inversely related to the thickness of this same placental membrane. A similar relationship may be demonstrated in Vygotsky’s and Bandura’s social learning theory:

\[
\text{Learning} = \frac{\text{Conspicuous Models} \times \text{Different Requirements} \times \text{Reinforcement}}{\text{Social and Economic Barriers}}
\]

1. *Highly conspicuous:* According to Bandura (1977, p. 54) “modeling serves as the principal mode of transmitting new forms of behavior.” Media provides symbolic modeling where the early adoption by influential leaders provides the most effective model. When attentive, people learn vicariously by watching and listening to those who act first (Bandura, 1977, pp. 39, 117; Rogers, 1995, pp. 52, 89). The intimate familiarity
with highly conspicuous models in this formula includes the social interactivity required in the zone of proximal development (Vygotsky, 1978, p. 86).

2. Reinforcement: “People who have been reinforced both directly and vicariously persevere longer in the face of nonreward than do those who have experienced direct reinforcement alone” (Bandura, 1977, p. 123). These kinds of reinforcement provide motivation.

3. Different requirements for adoption: Bandura (1977, p. 53) recognized that every idea has particular characteristics that influence the ease or difficulty of assimilation. To provide a comparable example from education we would say that learning to place a period at the end of a sentence would be different from learning to play the tuba. The premise for using strategies such as problem-based learning is that learning to think critically is more difficult than memorizing and recalling facts.

4. Social and economic barriers: Finally Bandura (1977) recognized the role that social and economic barriers may play in learning (p. 53). And so key variables that Bandura identified are easily arranged in a format similar to Fick’s law and conceptually they seem similar to the issues of surface area, pressure difference, solubility, and barrier thickness. This formula becomes instrumental in demonstrating how the findings of this research are aligned with the theoretical framework of social learning theory. A modification of terms is used to facilitate an understanding of this alignment.

\[
\text{Learning} = \frac{\text{Proximity} \times \text{Ease of Learning} \times \text{Motivation}}{\text{Learning Barriers}}
\]
1. **Proximity** in this study refers to a relationship between the student and human and symbolic models that determines the effectiveness of learning in the *zone of proximal development*, such as the close interaction with the faculty and student models, which is dependence upon the faculty-student ratio, peer-to-peer learning in the laboratory, or the time-to-faculty response in online education. This closeness conceptually seems to be similar to the need for surface area to enable gas exchange in the placenta and similar to the requirement that Bandura found that information and models must be highly conspicuous.

2. **Ease of learning** is the nature of the information to be learned just as each gas diffuses through the lungs at different rates depending upon its solubility and just as Bandura recognized that various ideas may be assimilated with more or less ease. This concept is here referred to as ease of learning. As an example, learning to think critically was considered by the faculty to be more difficult and would therefore have a low ease of learning, thus making more motivational support and intimacy necessary for learning to take place.

3. **Motivation** is similar to the difference in gas pressures which essentially pushes gases across the placental membrane. Where external motivation might be said to push for learning and we might think of internal motivation as the student’s pull to learn. These metaphorical differences in pressures are directly related to learning. Bandura described learning as directly affected by positive reinforcement and motivation. So the major finding of this study about the importance of motivation has a corollary place in the mathematical model.
4. *Learning Barriers* are illustrated by the placental barrier thickness and correspondence in social learning theory as “social and economic barriers.” Bandura’s terms are here conceptually expanded to include all learning barriers. These would include student disinterest, student learning disabilities, reading difficulties, instructor accent, and cultural barriers. The proposal then to respiratory care educators is to consider Fick’s law as a fun memory aid to help think about the corollary principles that will develop critical-thinking.

**Summary**

To deliver the data in a way that makes sense and connects with readers sufficiently to bear change is a question of writing and leadership. A bold development of the diffusion metaphor is used not only so readers will conceive how the results are interrelated with learning theory but also to emotionally grab them. This study issues two interrelated alternative representations: a metaphor and a mathematical model. One instructive aspect of the metaphor is found in the large surface area where the fetal villi grow into the rich capillary bed recently prepared by the mother. Here oxygen diffuses from a high concentration in the mother’s blood to a low concentration in the fetal blood in accordance with Fick’s law of diffusion.

Bandura and Vygotsky identified key dynamics involved in learning and these have been arranged in a mathematical model. The three thematic findings of this study align with two of the so-arranged social learning theory factors. This study proposes a modification of the social learning theory terms and a mathematical model. The formulaic representation of study findings and social leaning theory can serve as a useful vehicle for learning and discussing factors that influence the acquisition of critical-
thinking. It may appeal to respiratory care faculty because of its conceptual similarity to Fick’s law.
CHAPTER 6

SUMMARY AND CONCLUSIONS

Introduction

The complexity of respiratory care provides the background for this study. Respiratory therapists must be able to prioritize, anticipate, troubleshoot, negotiate, reflect, make decisions, and communicate with other health-care professionals (Mishoe, 2003, p. 500). The profession requires respiratory therapy education programs to prepare their students by developing competency in critical thinking (Kacmarek et al., 2009). For this study critical thinking is the “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990). Scholars (Mishoe & Welch, 2002) recommend using active strategies such as cooperative (Johnson et al., 1991; Van Horn, 2000) and problem-based learning (Ceconi et al., 2008; Mishoe, 1993) while tackling life-like complex problems in order to develop critical thinking. Working respiratory therapists must be able to move between different areas of the hospital and quickly develop rapport. If students learn information in classroom and laboratory settings that is dissimilar to those of the clinic they will be unable to use that information where it matters; they will not have developed the critical-thinking skills needed.

Select scholars have eloquently advocated and described methods such as
problem-based learning as a means of teaching critical thinking. The added insight from the front line faculty of a successful program on these issues has been missing.

No study has explored or described how a group of faculty, from their perspectives, organize the delivery of a respiratory care curriculum to develop critical thinking. Neither has any study considered broadly the strategies, techniques, and program characteristics that might contribute to improving critical thinking. And no case study has attempted to analyze the relationship between the practice of good respiratory care education and the related major veins of social learning theory. There really has not been a qualitative case study on critical-thinking education of this kind in respiratory care. Where previous research had carefully described the implementation of problem-base learning and program outcomes, a case study exploring the beliefs of faculty proficient in teaching critical thinking has been missing. A program director’s first-year experience with problem-based learning (Op’t Holt, 2000) and a subsequent quantitative study (Ceconi et al., 2008) of positive decision-making skills in the same program have been published.

This qualitative case study adds to the scholarship on developing critical thinking by adding the themes mined from nine audiotaped interviews of full-time faculty which were transcribed, coded, and considered in the light of classroom observations and program syllabi collected. The current study also adds a consideration of how good respiratory care practice corresponds to previous educational theory. This study provides a larger consideration of the educational techniques, strategies, and program components necessary to develop critical thinking rather than focusing on the implementation of problem-based learning alone. The current study broadens what a program should
consider when attempting to improve critical thinking. Publication of such case studies is essential so that the profession can develop a “nuanced” understanding of the realities of teaching critical thinking (Flyvbjerg, 2006, p. 223). This case study describes what those who are successful at developing critical thinkers in one program actually do and what they think. The purpose of this case study was to describe the beliefs and educational strategies currently used to develop critical thinking in an academically strong respiratory care program. Beachey (2004) advocated realistic qualitative studies that might help to explain under what circumstances strategies become effective (pp. 113, 114).

Because many of the active learning strategies recommended for the development of critical-thinking fall into the social learning class of strategies, this study uses social learning theory as a framework to consider the beliefs and strategies in respiratory therapy. The research questions are: What do expert faculty in a strong respiratory care program believe concerning the development of critical thinking? How are particular learning strategies consistently implemented by expert respiratory care educators to enhance critical-thinking and problem-solving skills in their students? Which program components best support the development of critical thinking? The chapter will begin by reviewing the theoretical framework followed by methodology, the results, a discussion, and conclusions.

**Theoretical Framework**

Social learning theory is a comprehensive theory (Bandura, 1977, p. 13) which attributes learning to the interplay between the individual’s thinking and actions and what they observe in the actions of others. In this theory one learns from the direct observation of others as models and from both verbal and written symbols (p. 13). Students also learn
by attempting tasks that just exceed their current independent ability to solve problems. In this zone of proximal development (Vygotsky, 1978, p. 86) the student collaborates with more capable peers under adult guidance. To accelerate learning, the source person or representation must be conspicuous and widely available (Bandura, 1977, pp. 50-55, 107-162). Advantages of this exchange with available peers and instructors are motivational factors because “many activities that enhance competencies are initially tiresome and uninteresting” (p. 104). After one acquires proficiency by first interacting with skilled peers and instructors, they become rewarding. Until then the peers and instructors help to generate motivation.

Aspects of motivation are central features of social learning theory. Motivation is dependent upon several factors including one’s own cognition. The ability of one to mentally represent future consequences is a source of motivation (p. 161). Bandura (1977, p. 162) identified goal proximity as another source of motivation. When a deadline approaches, people have a tendency to prioritize work and mobilize resources. Observing the success and failures of other people is an effective means of providing vicarious reinforcement and subsequent motivation (p. 117). Social learning theory does not regard extrinsic and intrinsic motivation as antithetical (pp. 104, 105). In addition to the exposure of individuals to knowledge and the reinforcements and motivation to learn, social learning theory also identifies the importance of barriers to learning and the unique qualities of the material to be learned as influencing the rate of acquisition. Perceived risks as well as social and economic factors are identified as barriers to learning (pp. 53, 54). The characteristic of the behavior or knowledge to be acquired is recognized as a factor influencing the rate of learning (p. 54).
Methods

A qualitative case study design was used to describe the beliefs and practices of expert respiratory care faculty on the development of critical thinking. The faculty were selected because they were employed by a strong program that was nominated by expert members of the Committee on Accreditation for Respiratory Care. Qualitative data were collected from classroom observation, audiotaped interviews of administrators and faculty, photographs of program laboratories, sketches, and program documents including syllabi, curricula maps, web-site material, and the student handbook.

Nine faculty were interviewed and audio-recorded. Interviews were transcribed, coded, and then mined for relevant themes using a cross comparative system. Interview transcriptions were returned to participants in the member-check process. Emerging themes were evaluated for correspondence with published research and theory and subsequently returned to senior expert faculty in a continued member check-process. Physiologic laws have been adapted to suggest educational relationships, and a physiologic metaphor was used to assist in understanding how relevant characteristics are interrelated and to suggest further understanding of the program components necessary to facilitate critical-thinking.

Results

The research questions for this case study were: What are the faculty beliefs concerning the development of critical thinking? How are learning strategies consistently implemented by expert respiratory care educators to enhance critical thinking/problem solving in their students? What program components support the development of critical-thinking?
Faculty Beliefs

The faculty beliefs centered on two primary concepts: the importance of faculty and students being highly motivated and that students learn by doing. Faculty who are excited about their work will exude this enthusiasm in their classes. Faculty enhance motivation by creating challenging learning assignments where the student’s own performance is a central topic of attention. First the students must work with their peers to identify questions, to research those questions, to bring answers forward, and then to present them. Then the students work together with their instructors to question, analyze, and contribute to improving that performance. This level of engagement creates a large emotional investment and increases motivation. Grading systems and points provide the motivation necessary to require the student to perform. As students see that they are gaining skill and knowledge, their motivation grows.

The participants in this case study emphasized the important role that faculty have in enhancing and supporting motivation not only by modeling passion themselves but also by expecting active participation leading to achievement. Bandura (1977, p. 104) reported that “it is not until after people acquire proficiency in” skills “that they become rewarding.” So until they are more intrinsically rewarding, the faculty help by modeling passion for the information and providing positive rewards in the course-grading structure. Faculty also motivate students to learn by tying classroom instruction to their clinical experiences so they understand the relevance. Students know the faculty are competent to keep them in line and this motivates students because they know they cannot slip by.
While the program faculty did speak positively about problem-based learning, they were unified in doing this while also equally emphasizing other educational methods and principles.

How Effective Strategies Are Consistently Implemented

The faculty work in a brand-new health science building with multiple, spacious, well-equipped laboratories and nine full-time highly educated and experienced faculty. The faculty are highly motivated and believe that their enthusiasm will help generate motivation in their students. The faculty organize challenging learning activities in which students interact with each other and with the faculty. This kind of cooperative work between students and students and faculty helps to support motivation.

Faculty recognize that students must practice the application of what they learn. They must learn by doing. Faculty use a number of techniques to provide support but they intend to not formulate or organize the problem for the student. Students are given opportunities to identify a problem, recommend a solution, and explain their own rationale. Just like in the clinical work after graduation, students must have practice working with other peers to solve problems. Faculty have to restrain their own tendency to formulate the questions and provide answers and instead give encouragement as the students do this work. Faculty organize learning sessions with faculty mentors for each small group, which is expensive but regarded as worthwhile. One objective is to stimulate academic controversy, that is, the students’ facts must be challenged. The objective is a give-and-take process among students and with faculty referred to as discourse. The rationale given is that they must learn to discourse with doctors. Program syllabi show that faculty require students to teach, present, and communicate. Faculty believe that the
best way to learn something is to teach it. Consequently, students make presentations to other students and they organize and deliver instruction to children in asthma camp. Students learn to evaluate and receive evaluations from each other though peer evaluations. Students are required to do an honest peer review, as opposed to one that glosses over the performance and reports that everything the student did was good. The faculty want to get the students to talk and believe that requiring students to answer questions will help them learn to think.

Faculty use problem-based learning as a major learning strategy for the development of critical thinking. A good understanding of the techniques organized in problem-based learning provides a conceptual framework and philosophy that informs the faculty and finds expression in a variety of courses. In PBL, group members identify learning issues and assign responsibilities for research to group members. Individuals research the questions and come back to the group to make presentations on what they learned. Group members question each other and rate each other’s contributions.

Within problem-based learning and in other learning activities faculty teach a system for interpreting and supporting clinical recommendations. The names given for these complementary systems are evidence-based practice and the whole-body approach.

In evidence-based practice the clinician recommends therapy based upon an hierarchy of supportive research. The whole-body approach uses knowledge of physiologic interactions within the body as the basis for recommendations.

Faculty consider reflection a major topic to bring up with students. Students are given assignments that encourage reflection. Student writing as well as evaluations at the
end of a clinic is a reflective process. Faculty ask students to remember events that they were a part of, and then they are asked to verbalize what was learned.

Essential Program Components

Several program characteristics were identified as necessary to engage the development of critical-thinking in the students. There must be an adequate number of faculty and expedient faculty-to-student ratios at points in the program. At certain points in the program there might be four to five students to a faculty member in a class. Sometimes in clinical instruction there could be one student to one faculty member. The fact is that this program enjoys several new and well-equipped laboratories, good clerical assistance, a program library, and nine full-time faculty members. Three of these faculty hold Ph.D. degrees and a remaining five hold Master’s degrees with one member being labeled nonfaculty while holding a B.S. degree. These faculty believe that graduate education is required of faculty to create the environment for the best learning of critical-thinking skills.

Bandura (1970, p. 136) observed modeling behavior to be dependent upon vividness and novelty. This case study shows that faculty who are passionate provide vivid and novel instruction. To have passionate or motivated students you need to have passionate faculty. The faculty require a student to meet with a faculty member every time they receive a grade less than a B on a program examination. These findings correlate with the work of Ari (2007), which showed the connection between high faculty qualifications and program expenditures and excellent outcomes.

Every quarter this program uses a departmental comprehensive examination to ensure that students do not wait to review and retain previously learned material. In this
way, they assure what social learning theory (Bandura, 1977, p. 162) labels “Goal Proximity,” so that the students will not procrastinate to prepare for credentialing examinations. The faculty advocate program prerequisites and high admissions standards in a recognition that these characteristics influence the students’ capacity for learning. Such characteristics are called social barriers in the social learning theory (p. 54). These are the kinds of programmatic and curricular variables the participating faculty maintain are also necessary to overcome common barriers and ensure the successful acquisition of respiratory care skills.

**Discussion**

The understanding that comes from this study is that learning critical thinking in respiratory therapy does not happen by accident. Critical thinking is developed in a special learning environment that is consensually created. The student must be ready to learn and this is why motivation is important. Students are going to be less motivated to learn from boring and unmotivated faculty. This kind of environment has previously been described by social learning theorists as the zone of proximal development. This condition is one where students perform at a level only possible when they are working with faculty and students (models) who are more knowledgeable than they are. The students must spend significant amounts of time observing and thinking about these actual or symbolic models.

This study shows that social learning theory applies when one talks about teaching critical thinking to respiratory therapy students. Analysis of the faculty interviews in this study go on to confirm social learning theory by emphasizing the importance of faculty and other students as models from which students may learn.
Students must be given challenges that can only be met while collaborating with other students and faculty in the theoretical zone of proximal development, but there are other aspects which are essential to learning. These other aspects confirm the findings of researchers that the number of faculty and the academic qualifications of faculty are important. Beyond the faculty even more program characteristics are integral to the effective creation of the zone of proximal development. In other words, besides having excellent educational techniques and strategies such as problem-based learning, you have to have (a) great faculty, (b) students who are oriented, motivated, and thus ready to learn, (c) an organized curriculum, (d) quality clinical education, (e) preparation for graduation, and (f) on-going program assessment. These programmatic characteristics are equally important and do not arise out of thin air. Program resources flow from the larger institution that cares about the quality of education in the classroom.

Analysis of the faculty interviews in this study bring us to consider the connection between the prior work of social learning theorists and research that clearly demonstrates the importance of faculty and resources to programmatic outcomes. The faculty said that what creates critical thinking is not one strategy but that it is “all that we do.” There is much that is important to make the whole educational process function well.

Because this study says that educational techniques, strategies, motivation, learning by doing, and program characteristics are important, a tension develops about how to communicate the information and make it useful. In the inevitable rush to summarily characterize or classify research findings, much can be lost that is useful. Research findings may be minimized and subsequently discarded as inconsequential.
Despite this, for research to become known it needs a conceptual vehicle that holds the essential ideas, tantalizes, and uses an economy of time and space to communicate.

The metaphor of the zone of diffusion which occurs in the placenta and the intimate relationship between the mother and fetus around this area aptly represents the zone of proximal development without minimizing the complexity of all the interactions. The truth is that real education is complex, but this complexity can be understood and a metaphor can be used to convey the key relationships between the individual components. This is a good metaphor for respiratory therapists who love physiology.

The study’s findings can be thought of in relation to earlier scholarship. According to Beachey (2004), “A realistic evaluation . . . would begin by examining what activates particular learning mechanisms in particular contexts to produce desired outcomes, and would end by generating” knowledge “specific enough to inform changes in the program studied, and yet be transferable to the wider educational community” (p. 113). The major finding of this case study is that the message is “do not forget the basics.” There is not a single panacea but the answer lies in tending to many basic things consistently. The answer to developing critical thinking is that the engaging use of questioning and case-based instruction, discourse, simulations, and problem-based learning are effective when they have the right structure. And that structure includes beneficial faculty-student ratios, highly qualified and passionate faculty, and adequate classroom, laboratory, clinical, and curricular resources. Students who learn are those who are ready to learn are fully engaged and have a sort of scaffold created by the faculty and with the program resources. The important thing is not so much the question of whether the program is using problem-based learning or not, the factors that make a
difference have to do with the answers to the following questions: How does the program provide for student motivation? Does the program ensure that the student must learn by doing? Does the program have a scaffolding system to ensure that the student is fully engaged with program resources including faculty for significant periods of time? When problem-based learning is implemented in a way that ensures a positive answer to these questions, then critical-thinking is enhanced. And when other educational strategies such as writing and making presentations and debating are employed in a similarly rich way, critical thinking will also be enhanced. Critical thinking cannot develop as well in the clinical environment when there are not motivated and well-qualified preceptors who fully engage the student.

Whereas Beachey (2004, p. 113) said that a qualitative study would generate theories that could inform the wider educational community, this study offers a metaphor of placental gas exchange. The acquisition of critical-thinking skills in the zone of proximal development is governed by factors similar to those governing the diffusion of gases across the placenta. The metaphor helps to emphasize the importance of the study’s findings. In the placenta as in learning there are a number of factors that must be present. We know that the mother’s tissues and those of the fetus are extremely close over a wide surface area, and that pressure differences and both maternal and fetal involvement are essential to the transfer of gas. In a similar way we know that the close contact between the students and faculty, motivation support, and learning by doing are likewise critical in the zone of proximal development. And so this case study offers an interesting metaphor, a vivid picture to stimulate discussion, abstraction, extension, and memory. A mathematical model shows that the rate of learning is directly dependent upon a
motivation which creates a readiness to learn as described by Bandura and the close interaction or attention of the student to student and faculty models as described by both Bandura and Vygotsky. This is the zone of proximal development where there are student and faculty models which help the student perform at a higher level than they could otherwise. The model also shows that learning is dependent upon the support for motivation, the nature of what must be learned, and any learning barriers. This case study extends the conceptual framework of the zone of proximal development and social learning theory by showing its integration and dependency upon the program characteristics described in research. The model of the placenta and the mathematical model are used to facilitate the discussion of factors that are necessary to foster critical-thinking.

We should not be surprised that the findings of this case study are principles that have also been reported by educational scholars in other settings. Education in respiratory care is unique, but it still involves the challenge of transmitting skills and knowledge that are common to other professions and educational settings. The specific knowledge and skill to be transmitted is unique, which means that the findings of educational research are to be adapted but not disregarded as irrelevant. The impact of this case study will be clearly governed by the same principles of learning iterated by Bandura (1977, pp. 51-55) and this study. If this case study becomes highly conspicuous (p. 51) and is endorsed by prominent models, and if the metaphor is found to be of functional value, educators may use this study as a vehicle for the discussion of educational dynamics. This case study provides the type of context-dependent knowledge that contributes to true expertise (Flyvbjerg, 2006, p. 239). The impact of this study could be significant by providing an
interesting metaphor that will help educators concisely remember key variables that support the acquisition of critical-thinking skills. If it does, it has the potential to warn program faculty about trying to resolve resource problems with an educational strategy. It has the potential of helping programs and administrators to differentiate, or at least debate between what really counts among the infinite variables that influence education. Ultimately, such discussions have an enormous potential for improving education. Even if these metaphors and mathematical models only stimulate discussion and the ultimate adoption of other better models results, it still will have contributed to the discussion and interest.

The preceding discussion shows how this case study validates social learning theory, the zone of proximal development, and previous research. The faculty iterated the importance of motivation at several levels; they pressed the importance that students learn critical-thinking skills by doing. They did advocate the use of a number of important strategies and techniques that all serve to confirm social learning theory. They also advocated for faculty, program curricula, and support that have been shown in previous studies to correlate with program outcomes. This study also extends the theoretical framework by proposing a metaphor and mathematical model that show how the motivation and close work with student and faculty mentors integrate with other findings in research in a complex biological metaphor.

**Recommendations**

In the light of this study there are several recommendations that can be made for multiple stakeholders. The recommendations for each of these groups follow.
American Association for Respiratory Care

Recommendations to the American Association for Respiratory Care (AARC) are that it continue to offer the “Educator Academy” where faculty members can share their experiences in motivating students and implementing active learning strategies. The “Educator Academy” is also a venue for sharing knowledge on how to improve program characteristics.

Committee on Accreditation for Respiratory Care

The recommendations for the Committee on Accreditation for Respiratory Care (CoARC) are to consider a phased-in plan to require that new program directors and new directors of clinical education complete training in allied health education. It is recommended that the CoARC proscribe that faculty in programs having difficulty meeting accreditation thresholds, take university courses that are specific to motivation, learn by doing and program organization. The faculty in these struggling programs may suffer from isolation and are best exposed to the knowledge resident in successful programs. It is recommended that the CoARC continue with the requirement that programs having difficulty meeting credentialing examination thresholds complete progress reports tied to resource assessments.

Department Chairs

The recommendation for department chairs is that they provide well-equipped laboratories and access to professional training in education and to successful faculty in other programs. Then department chairs must hold the program director, the director of clinical education, and the faculty responsible to ensure strong program outcomes.
Program Directors

The recommendation for program directors is that they screen faculty applicants carefully for passion and insist upon high academic qualifications. Program directors must make sure that their faculty know how to plan for active learning. Program directors should review course syllabi to ensure organization and grading structures that focus attention appropriately. Adjunct or part-time faculty who do not display passion and ambition are not to be moved into full-time positions.

Directors of Clinical Education

The recommendation for the Directors of Clinical Education is to give particular attention to the quality of the instruction provided by preceptors or clinical instructors. Preceptors are to have training in how to provide the questioning and activities that tie didactic theory with practice. The student’s clinical records and evaluations focus attention and student motivation. Based upon the theoretical framework and study findings, it is imperative that professional communication is initially modeled by the clinical instructors in the clinical area. The clinical instructor must model communication with nursing, other allied health professionals, the respiratory care staff and supervisors, and with physicians. The job of modeling communication processes must not be left to tired, burnt out, and unpaid staff therapists. Clinical faculty are to have the flexibility to take some time away from patient care schedules to discuss clinical events and reflect on the implications. It is recommended that students are required to communicate with nurses and physicians and that they receive graded feedback on their communication.
Faculty

The recommendation for faculty is that they focus on planning. Active learning that results in critical-thinking does not come by accident. Those who execute problem-based learning or other active learning strategies successfully have well-organized, written plans. The course syllabus must be constructed to provide points for the activities. Well-executed learning activities are not easier than providing a lecture; they require more planning and close attention by faculty during implementation and in grading. The proper execution of activities that require peer review require the highest levels of faculty skill. If peer review is not planned carefully, students will not provide effective feedback. Faculty must learn to widen the repertoire of learning activities they use. Faculty should find avenues to share and learn practical knowledge from other faculty from other programs. Faculty must be able to professionally implement points and grades that will assure generalized classroom management and motivation. Didactic faculty are to study the effect between their own motivation and their grading structure and the motivation of the students. All faculty are to be or become experts in what they plan for students to learn and they are to become experts in what facilitates learning. To grow as a faculty member, one explores previously unfamiliar educational strategies. Expert faculty learn to construct a syllabus, lesson plans, and grading systems that require the students to fully engage the subject, to be able to find information, to present it, and to be open and positively engage those who see things differently. They construct a curriculum that rewards the development of communication skills. Students learn by doing, and what makes a respiratory therapist proficient in intervening to save lives has to do with collaboration. Programs need to provide students with practice in this area.
The findings of this research are that faculty can spread a wave of enthusiasm for learning respiratory care. Since motivation is the motor that helps us all to work and study, this aspect of education merits time in our professional discussions.

Students

The recommendation to students is that they fully participate in their learning. Students should realize that the faculty want them to succeed. Faculty work very hard to help students learn. When students learn, the program outcomes improve and the reputation of both the program and faculty increases. The future success of students and faculty are tied closely together. With this realization students should try to work to accomplish what the faculty have in mind. Respiratory therapy is fascinating and rewarding work. There are many challenging concepts and skills to master but these challenges can be both a source of interest and motivation.

Future Research

Future research is needed into how the community can assist a program in moving from one with inadequate faculty and program resources to a program with the generous resources needed. Since the profession, prior research, and this study advocate for faculty with graduate education, more studies are needed as to the development of graduate respiratory care programs. Since program faculty and resources have been shown to influence program outcomes, future qualitative narrative studies that tell the stories of how strong programs have developed the broad university influence necessary to secure resources are needed.

Many programs across the United States do not have nine full-time faculty members. They have two. Scholars should search these two full-time faculty programs
for one with excellent outcomes. Such programs should be studied qualitatively because these would help the majority of respiratory therapy programs identify how a program more like their own excels.

At EMSU critical thinking is developed by engaging students in learning by doing with peers, with motivated faculty, and liberal resources. Interaction with motivated peers and faculty is a demonstration of social learning theory in respiratory care education. This extension of social learning theory suggests that learning is directly related to the interaction and cooperation of the students to human and symbolic models, to the ease of the subject matter to be learned, to levels of motivation and indirectly related to learning barriers. Research is needed outside of respiratory care to see if the same relationships are observed there.

**Conclusions**

According to expert faculty, the elements necessary to successfully enhance critical-thinking strategies encompass student learning by doing and motivational and programmatic components. Faculty should not provide students with too much information because this robs them of learning to identify the information they need and of the skill in finding that information. Faculty must be passionate and know how to provide external motivators when students initially lack sufficient internal motivation. Any program that seeks to develop critical thinking must possess program characteristics including adequate faculty numbers and training. Curricular structure is needed that provides for optimal faculty-student contact and curricular organization requiring high levels of discourse. All of these findings can be illustrated in the metaphor of the placenta with the intimate contact provided by the large surface area at the interface between the
fetal villi and the mother’s blood. The pressure differences between the oxygen in the mother’s blood and that of the fetus also determine the rate of diffusion. The relationship of these factors is described by Fick’s law of diffusion, which suggests a similar mathematical representation for the diffusion of critical-thinking skill to the respiratory care student.
APPENDIX A

FACULTY/ADMINISTRATOR INTERVIEW PROTOCOL FOR QUALITATIVE STUDY
FACULTY/ADMINISTRATOR INTERVIEW PROTOCOL FOR QUALITATIVE STUDY

Opening:

Explain my background as respiratory therapist for 23 years

Full time respiratory faculty member for 20 years as director of clinical education and program director.

Doctoral student at dissertation phase

Initiated a new bachelor of science degree program in respiratory care

Introductory questions:

For how long have you been a faculty member or Administrator of a RC program?

What attracted you to this college/university?

Transition question:

What attracted you to respiratory care education?

Key question:

How do your students learn respiratory care content? (This question is aimed at seeing how much content is learned in an experiential setting and how similar the setting is to practice (Czachowski, 1994; Hess, 1997; Op't Holt, 1994))

What are the critical-thinking pedagogies used by your program?

Probe: Please describe examples of activities you use in your program and how students have responded to them.
Probe: Why do you think these strategies work?

Probe: Describe ways you have adapted your instruction.

How did you come to adopt these [critical thinking] approaches?

How are your students prepared to take the clinical simulation examination? (The clinical simulation examination is recognized as measuring domain specific critical thinking. How does the program see itself preparing students for this examination? (Goodfellow, 1999))

Probe: Does your program facilitate reflection? If so how? (Reflection has been identified as an important component to the development of critical thinking)

Which methods would you recommend to other faculty as important for the day-to-day development of critical thinking?

Why do you believe these strategies work?

Probe: What are your beliefs about respiratory care education?

Probe: What are your beliefs about how people learn?

Probe: In my observations of instruction on your campus I noticed these instructional activities, what was the purpose of these activities?

Probe: How do you evaluate the individual learning activities that your program employs?

What would you recommend faculty do in order to become effective in organizing critical thinking learning activities?

How can a program that practices traditional methods of instruction transition to active methods?
Final Question:

Is there anything else you would like to tell me about how your program plans for the development of critical thinking.
APPENDIX B

QUALITATIVE CONSENT FORM
BELIEFS AND PRACTICES OF RESPIRATORY CARE FACULTY ON CRITICAL-THINKING STRATEGIES

James Hulse, Doctoral Student

I am a respiratory care practitioner by profession and have worked as a Director of Clinical Education for 13 years and as a Program Director for 7 years. I am conducting a research study about the organization of learning experiences to enhance critical-thinking and decision making.

In this study, I will qualitatively study one respiratory care program recognized as strong by members of the Committee on Accreditation for Respiratory Care (CoARC). I will travel to the institution to elicit expert knowledge on critical-thinking for the development of a survey. During the expert study I will code the responses of participants to preserve your anonymity. At no time will your name be used in the research study or in any subsequent publication of the research. Program artifacts will be collected including program curricula, lesson plans and other directions of individual activities of interest. The data will be kept secure during the research process and destroyed after the research has been approved. All information collected will be held in strictest confidence.

The data gathering process will involve an interview at a mutually agreeable time and location. The length of the interview is negotiable, duration of approximately one hour in duration would be valuable and will be tape recorded so that I can assure accuracy in reflecting your thoughts and perspectives as I analyze the data. During the interview I will ask you a series of questions pertaining to your involvement in educational activities. There are no “right” or “wrong” answers to the questions I will pose. I am seeking your perceptions.

Audio tapes will be transcribed by a person not affiliated with your college or university. I will provide you with the interview transcription and ask you whether it accurately reflects your perceptions. We can accomplish this review through e-mail and phone contact.

Your decision to participate or not to participate will not affect your standing at your college/university in any manner.

The entire data collection process will extend from September 1, 2005 to December 31, 2006. You are free to withdraw from the study at any time. If you have any questions concerning this project or the consent, please call James Hulse at (541) 245-7516 or Dr. Shirley Freed at (269) 471-6163

I, _______________________________ hereby give my consent to participate in the research study described above. I have read and understand the statement and have had all my questions answered.

_________________________________________  ___________________________________________
Date                                                                                   Participant
REFERENCE LIST
REFERENCE LIST


VITA
VITAE

Name     James L. Hulse

Department  Respiratory Care

Academic Rank and Title  Assistant Professor and Program Director

Year of OIT Employment  2004

Academic Degrees

Doctoral Candidate, Leadership, Andrew’s University, 1999-present
M.P.H., Public Health, Health Services, Loma Linda University, 1983
B.S., Public Health, Loma Linda University, 1981
A.S, Respiratory Therapy, Loma Linda University, 1980

Professional Licenses and Certificates

Registered Respiratory Therapist, Number 13663  11/21/81
Certified Respiratory Therapy Technician  03/12/83
Certified Pulmonary Function Technologist  12/01/84
Registered Pulmonary Function Technologist  12/01/90
Perinatal/Pediatric Respiratory Care Specialist  03/09/91
Respiratory Therapist Licensing Board 0922000032 expires 06/30/10

Academic Experience

June 2004-Present - Program Director and Assistant Professor, Respiratory Care Dept., Oregon Institute of Technology
September 1998-June 2004 – Program Director, Respiratory Care, Rogue Community College
September 1984-June 1998 – Director, Clinical Education, Rogue Community College

Professional Experience

9/83 – 9/94  Staff Therapist, Rogue Valley Medical Center
9/80 – 8/83  Inter-laboratory quality control for NIH study through human physiology or pulmonary function laboratory, neonatal lead and transport therapist, Loma Linda University Medical Center

Awards

2007  Golden Stethoscope Award from the Oregon Society for Respiratory Care
For outstanding contribution and leadership in service to the State and the respiratory care profession