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Educating Genetic Counseling Graduate Students :Impact of Year of Training, Learning Styles, and Use of Practice-Based Learning on Satisfaction with the Learning Environment

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EDUCATING GENETIC COUNSELING GRADUATE STUDENTS: IMPACT OF YEAR OF TRAINING, LEARNING STYLES, AND USE OF PRACTICE-BASED LEARNINGON SATISFACTION WITH THE LEARNING ENVIRONMENT

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ABSTRACT

Formal education of master level genetic counseling trainees has occurred since the 1970s; however, unlike other health care disciplines there has been no research conducted into their learning styles. Practice-based learning is widely utilized in the medical school setting; however, it is unknown how extensive this teaching modality is used in the genetic counseling training programs. Use of this experiential learning technique has proven to be perceived positively by trainees in other fields. Furthermore, assessments of student satisfaction within genetic counseling training programs have not been performed. The purpose of this study was to determine the variables that affect genetic counselor trainees' learning styles and factors that influence student satisfaction specifically related to the learning environment, including the perception of practice-based learning (PBL) techniques. Overall, trainees are satisfied with the varied teaching techniques used within the genetic counseling training programs. According to the data, programs do not significantly modify the amount of PBL utilized between first and second year of study. Learning styles were assessed through the Kolb Learning Style Inventory and one predominant style did not emerge among the study sample. Additionally, there was no significant difference between first- and second-year trainees with regard to overall learning styles. Satisfaction with the learning environment was

evaluated by the Genetic Counseling Training Learning Environment Scale which indicated trainees are satisfied with varied facets of their training programs. Structural equation modeling was used to determine which factors influence favorable ratings of the learning environment. The most significant finding from this study is that the perceived use of PBL instruction increased student satisfaction regardless of year of study. There was a slight increase in satisfaction for those with the converger learning style compared to the other three learning styles described by Kolb. Based on the results of this study, genetic counseling training programs have the opportunity to enhance student satisfaction by assessing the teaching techniques used within their respective programs.This study helps close the gap in the literature regarding educational practices in the genetic counseling profession and adds to the adult education literature.

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CHAPTER I

INTRODUCTION TO THE STUDY

Adult education has existed since colonial times albeit conducted mostly in an informal manner; however, formal efforts to educate adults date back to the 1600s (Stubblefield & Keane, 1994). In the 1900s, educational efforts were based on the presumption that adults learn in a similar manner as children and educators based their principles of learning on the basic psychology of learning. Many of these learning theories are rooted in concepts put forth by psychologists such as Maslow, Piaget, and Rogers. The five most common theories that represent learning are: humanism, cognitivism, behaviorism, social learning, and constructivism. Depending on the theory, the motivation to learn may be internal to the learner or externally based. Humanistic theorists purport that learning is internally driven, whereas behaviorists contend that learning occurs by external influences (Gage & Berliner, 1988; Maslow, 1970; Merriam, Caffarella, & Baumgartner, 2007; Pavlov, 1957; Rogers, 1983; Skinner, 1954; Watson, 1930). However, other philosophies, such as cognitive learning, assert that learning is achieved by the individual making meaning out of their memory, understanding, and retention of information (Bruner, 1965; Köhler, 1929; Lewin, 1951). Social learning takes into account the role one's society and culture contributes to learning. Like the

other perspectives, the individual is central to the learning process; however, learning takes place by modeling behavior and social interactions (Bandura, 1986; Grusec, 1992). The last perspective is constructivism, and theorists who embrace this philosophy assert that individuals make or construct meaning from their experiences; however, learning is grounded in intrinsic forces and motivation (Dewey, 1938; Kuhn, 1970; Marquardt & Waddill, 2004; Merriam, Caffarella,& Baumgartner, 2007; Piaget, 1972). Although there are several perspectives on how people learn, these theories were not created with the adult learner in mind.

Although the concept of adult education began in the 1930s, a major shift in philosophy was seen in the 1970s which recognized that the adult learner is different from the juvenile learner. Several psychologists and theorists have put forth models as to how adults learn (Merriam, Caffarella,& Baumgartner, 2007). One of the earliest individuals to recognize the differences between the young and the older learner was Malcolm Knowles. According to Knowles (1988), there are four assumptions one makes in order to shift from the typical pedagogy to andragogy and these notions are on a continuum as a person matures. The four assumptions are: (1) one's personality becomes less dependent and develops into a self-directed person; (2) a person builds on his/her collection of experiences which acts as a resource for learning; (3) the motivation to learn is based upon a social readiness; and (4) there is a sense of timeliness that is not seen previously, in that what is being learned is now applicable to one's current situation, thereby having an increased sense of requiring the knowledge in order to perform a task or job.

Knowles' assumptions are echoed in many of the adult learning theories which can be divided into four areas; self-directed learning, experiential learning, critical reflection and adult learning styles (Brookfield, 1995). In the first model, self-directed learning, the adult learner is responsible for acquisition of information and is responsible for doing so at his or her own pace. In addition, the learner is responsible for evaluation of the learning process and to identify which resources are needed to achieve defined goals. The second model, experiential learning, focuses on the role experiences have on the learning process and that the accumulation of experiences leads to acquisition of knowledge. Critical reflection,the third model, is comprised of three interrelated processes: (1) questioning and reorganizing ideas which have been assumed to be correct; (2) taking an alternate stance about a previously held concept; and(3) recognizing the cultural dominance of values and how that can actually help promote issues related to minorities (Brookfield, 1995). Others classify this latter model as transformational learning (Merriam, Caffarella,& Baumgartner, 2007). Transformational learning is another hallmark of adult learning theory. This learning theory is mainly attributed to Mezirow who believes that we learn by changing our frames of reference (Mezirow, 1997). Adult learners are often presented with a disorienting dilemma, in that previous held assumptions are called into question which leads to a need to modify our beliefs and values. Self-reflection is a critical component in achieving transformational learning which often needs to be done in the context of discourse (Cranton, 2002; Mezirow, 1996). Lastly, the adult learning styles model focuses on the understanding that adults vary their ability to learn in different situations through multiple modes of learning. One can appreciate that these adult learning theories incorporate some of the concepts from

the early learning perspectives; however, the adult learning theories recognize the differences in psychological development that occur in adulthood.

There are several learning style theorists and accompanying inventories which have been created to assess one's preferred learning style. Various learning theories focus on different aspects of learning such as experience, reflection, or organization of information and have roots in both the traditional learning perspectives, as well as adult learning theories. Additionally, some theorists approach learning by the means of how individuals integrate information, for example whether one learns visually, aurally, or by reading (Coffield, Moseley, Hall & Eccelstone, 2004; Felder & Silverman, 1988;Fleming & Mills, 1992;Gregorc Associates, 2010; Hawk & Shah, 2007; International Learning Styles Network, 2008; Kolb, 1984; Kolb & Kolb, 2009;Mind-Styles, n.d.).

In order to enhance the learning experience of adult learners, it is purported by some that having an understanding of their learning styles can achieve this. Once these styles have been identified, curriculum can be developed which create an effective learning environment. Several inventories have been developed that assess both learning style and teaching style. By utilizing varied inventories, several aspects of learning can be evaluated. Hawk and Shah (2007) believe that it is important to incorporate more than one inventory when conducting research in this field. Based on their research, they assert that by assessing learning styles and subsequently employing correlated teaching techniques there will be five outcomes for the adult learner: (1) increased satisfaction; (2) increased performance in the class; (3) deeper learning and retention; (4) enhanced learning styles within and beyond the class; and (5) even higher performance will be achieved when assessing with more than two inventories.

While some researchers contend that effective learning can be achieved by assessing learning styles, others do not support this assertion. Pashler, McDaniel, Rohrer and Bjork, (2009) argue that learners can acquire knowledge by several learning styles, thus it is not beneficial to focus on one specific style. In these authors' critique, they assert that studies have not supported the idea that learning outcomes are increased when students are taught to their learning style. Further criticism stems from the lack of cohesiveness and common vocabulary describing learning styles among those who contribute to this field (Coffield, Moseley, Hall & Eccelstone, 2004). Concerns have also been raised about the psychometric properties of the various learning style inventories which lead to questions about the utility of these measurements (Coffield, Moseley, Hall & Eccelstone, 2004: Pashler, McDaniel, Rohrer & Bjork, 2009). Although criticisms about incorporating learning styles into the classroom to attain effective teaching exist, the same researchers who criticize this practice also recognize there may be some benefit in evaluating learning styles. Specifically, that awareness of learning styles and engaging in dialogue about them can assist in promoting change in the educational setting (Coffield, Moseley, Hall & Eccelstone, 2004).

Research into the learning styles of various professions has occurred throughout the years. Many studies have been conducted to determine if particular groups of students fall into one specific type of learning style (Alkhasawneh, Mrayyan, Docherty, Alashram,& Yousef, 2008; Baker, Pesut, McDaniel, & Fisher, 2007; Breckler, Joun, & Ngo,2009; Contessa, Ciardiello, & Perlman,2005; French,Cosgriff, & Brown,2007; Hauer, Straub, & Wolf,2005; Katz& Heimann,1991; Lujan& DiCarlo,2006; Mammen, Fischer, Anderson, James, Nussbaum, Bower, et al, 2007; Meehan-Andrews, 2009;

Murphy, Gray, Straja, &Bogert,2004; Stutsky,1995; Suliman, 2006). It would stand to reason that if a specific learning style was prevalent in a particular profession, then perhaps training programs for this vocation could create a teaching environment which could enhance that learning style. Several studies have assessed the learning styles of allied health professionals and medical residents;however, no such research has been conducted in the field of genetic counseling.

Genetic counselors are allied health professionals who are currently trained in master's level graduate school programs throughout the United States and Canada. As this is a relatively new health care field, there is a lack of information regarding the instructional strategies employed in the training of these professionals. Many of the training programs are housed within medical schools; therefore, these programs may employ practice-based learning techniques as this modality is now mandated for medical schools. Practice-based learning (PBL) is grounded in self-directed learning, utilizes experiential learning, the student is central to learning and problems that reflect are used to enhance learning (Barrows, 1996). Practice-based learning or problem-based learning, used synonymously in this study, is the transfer of knowledge by incorporating problems or cases to provide context and meaning, a key theme in constructivist learning. Learning also occurs by collaboration with peers in small group settings, the teacher acts as a facilitator of learning rather than imparting knowledge to the student(s), and employs self-directed learning (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005; Schmidt, Rotgans, & Yew, 2011). Several studies have documented the increased effectiveness of PBL in medical schools and other health care training; however, such an assessment has not been conducted in the genetic counseling training programs (Curtis,

Indyk , & Taylor, 2001; Enarson & Cariaga- Lo, 2001; Ogrinc et al., 2007; Shenouda, Swenson, & Fournier, 2003; Stuart, Sectish, & Huffman, 2005; Susarla et al., 2003; Thomas et al., 2005; Whitfield et al., 2002).

In addition, there have been no studies conducted to describe the learning styles of this cohort of trainees as has similarly been performed in other disciplines within health care. Overall, genetic counseling graduate trainees are largely an untapped group of individuals and little information has been captured regarding their training. The field of genetics is expanding; therefore, there is a need to increase the number of training opportunities for these prospective professionals. For that reason, an assessment of how the field trains these graduate students not only provides useful information for the respective programs, but has the potential to enhance the education of future genetic counselors which would ultimately benefit consumers of genetic services.

Student satisfaction regarding the didactic portion of genetic counseling training is another area that has not been evaluated to date. One approach to measure student satisfaction is to assess students' perception of the learning environment which has been accomplished in other health care fields, although this type of assessment has not been conducted within the field of genetic counseling. Gaining an understanding of the satisfaction with the learning environment is critical as this perception impacts student attitudes, student satisfaction, and can allow program administrators to analyze the need for curricular changes (Clarke, 1984). Evaluation of the learning environment in the context of PBL has been conducted by investigators which demonstrate that use of PBL tends to enhance the overall satisfaction with the learning environment (Lancaster, et al, 1997; Lieberman, Stroup-Benham, Peel, & Camp, 2001).

Statement of Problem

Although formal training of genetic counselors has occurred since the 1970s through master's level training programs, there has been no research conducted into the learning styles of genetic counselors. The evaluation of learning styles of genetic counseling trainees can bring the topic of learning styles to the surface so that discussions can ensue about what is occurring within the genetic counseling training programs.

Additionally, an assessment of student satisfaction pertaining to those enrolled in master-level genetic counseling training programs has not been conducted. Evaluating student satisfaction by assessing the perceptions of the learning environment could provide useful information, as well as determining the variables that influence learning environment scores. In addition, an assessment of the learning environment would be important to undertake as increased levels of overall satisfaction have been shown to increase professional attitude, retention in the field, and commitment to the field (Stith, Butterfield, Strube, Deusinger, & Gillespie,1998; Ziaee, Ahmadinejad, & Morravedji,2004). Approximately 75% of genetic counselors have less than ten years of experience in the field (NSGC Professional Status Survey, 2012). Although there are likely more personal reasons than programmatic or organizational reasons with one's training program that influence why genetic counselors do not remain working in the field for many years, it is possible that increased levels of satisfaction with their training would increase retention in the field. While program directors cannot alter the personal reasons for their students' duration in the field, they can address satisfaction issues within their respective training programs. Institutional factors that have been previously documented that increase satisfaction are to employ educational activities which are

small group based and to incorporate experiential teaching techniques (Emmons, Sells, & Eiff, 2002; Henzi, Davis, Jasinevicius, Hendricson, Cintron, &Isaacs, 2005). Other aspects related to the learning environment, such as nurturance, support, flexibility of the curriculum, relevant instructional materials, can be assessed and potentially modified by program administrators (Henzi, Davis, Jasinevicius, Hendricson, Cintron, &Isaacs, 2005; Marshall, 1978).

Purpose of Study

The purpose of this study was to examine whether the learning styles of trainees in genetic counselor training programs, trainees' year of study, and trainees' perceived use of practice-based learninginfluence satisfaction with the learning environment.

Research question.

1. Do trainees' learning style, year of study, and perceived use of practice-based learning have effects on satisfaction with the learning environment?
    a. *Hypothesis 1:* The learning styles of genetic counseling trainees have a direct impact on the satisfaction with the learning environment.
    b. *Hypothesis 2:* Perceived use of practice-based learning has a direct impact on satisfaction with the learning environment.
    c. *Hypothesis 3:* Genetic counseling trainees' year of study has a direct impact on learning styles.
    d. *Hypothesis 4:* Genetic counseling trainees' year of study has a direct impact on perceived use of practice-based learning.

e. *Hypothesis 5:*Genetic counseling trainees' year of study has both a direct impact and an indirect impact through learning style and perceived use of practice-based learning on satisfaction with the learning environment.

Definition of Terms

The following definitions and terms will assist the reader in comprehending the information and terminology used throughout this study.

Adult learning. The field of study relating to how individuals who are considered adults gain knowledge.

*Genetic counseling. "*Genetic counseling is the process of helping people understand and adapt to the medical, psychological, and familial implications of the genetic contributions to disease" (Resta et al, 2006, p. 79).

Genetic counselor. An individual who has received a master's degree from a graduate training program that is accredited by the American Board of Genetic Counseling.

Learning environment. "The sum of the internal and external circumstances and influences surrounding and affecting a person's learning" (Learning environment, n.d.).

Learning styles. The manner in which adult learners prefer to integrate educational information.

Practice-based competencies. Distinct areas of skill that graduate programs accredited by the American Board of Genetic Counseling must provide its trainees so that an entry-level genetic counselor can demonstrate a minimum level of aptitude when providing clinical care (American Board of Genetic Counseling, 2008).

Practice-based learning. Self-directed learning that is aimed at continual improvement. Instructional methods include, but are not limited to, role plays, small group discussion, and case-based instruction.

Structural equation modeling. A statistical modeling method that combines regression and factor analysis. This analysis allows for determination of relationships between theoretical constructs and the end result is often depicted in a path model indicating the relationships between variables.

Student satisfaction. The degree genetic counseling trainees believe their training program fulfills their educational needs.

Teaching modalities. The instructional methods or techniques used in the classroom by program faculty to enhance learning.

Year of study. Classification used for study population that indicates whether a particular subject is in his/her first or second year of training within his/her graduate program.

Study Significance

The outcomes of this study can be applied in three different manners. First, this study helped close the gap in the literature regarding educational practices in the genetic counseling profession. Although there are several studies related to education of medical professionals, there are none which address the specific profession of genetic counselors. Furthermore, this study has the potential to impact the genetic counseling profession by informing faculty within the field to better understand their students' preferred learning styles. By performing an assessment of student satisfaction with regard to learning environment, the genetic counseling training programs have the opportunity to gain an

increased understanding of how to enhance the student experience. This in turn has the potential to ensure graduates from these training programs are more committed to the genetic counselor workforce and have increased retention in the field. Therefore, these data can offer program administrators further information about potential areas for improvement.

Second, from the adult learning viewpoint, this study provided the adult learners in the field of genetic counseling the ability to enhance their learning or knowledge by providing them with information about their preferred learning style(s). The results of this study also provided the participants of this study with an opportunity for critical reflection,a key principle of adult learning, relating to their learning styles. In addition, this study adds to the adult learning literature specifically that which relates to learning styles from the standpoint of another professional group, genetic counseling. Third, this study contributes to the adult education field by evaluating the use of practice-based learning in the training of a specific professional group. As practice-based learning incorporates self-directed learning, reflection, and experiential learning, concepts that arevital to adult education, the results from this study can bring to light these ideas from the context of a unique health profession. Lastly, this study has the potential to encourage further research in this area.

CHAPTER II

REVIEW OF RELATED LITERATURE

Genetic counseling is a relatively new field in health care, compared to other health disciplines as the formal education of genetic counselors began in 1969. As such, there is a paucity of literature regarding the training of genetic counselors. Additionally, there are no studies regarding learning styles of genetic counseling trainees or research into the teaching styles of their instructors. This chapter will provide the reader with a historical perspective regarding the field of genetic counseling and genetic counselors. The limited literature related to education of genetic counseling trainees will also be presented.

In order to provide a framework regarding learning styles, this chapter will also address learning theories, adult learning theories, and learning styles and related inventories. As student satisfaction is a variable being explored in this present study, a review of literature in this area will be addressed. A focus on studies that pertain to the education of health care students will be presented. Lastly, a review of the literature related to the learning environment and associated inventories will be presented with a focus on health care training.

Genetic Counseling

Concerns about passing on hereditary conditions date back as far as Biblical times. However, counseling provided to couples about the recurrence of hereditary conditions in their offspring, was formalized when several medical centers opened hereditary clinics in the 1940s (Resta, 1997). The term "genetic counseling" was created in 1947 by Sheldon Reed, one of America's pioneering geneticists. Initially the counseling was provided by physicians and while medical geneticists still provide genetic counseling services, in 1969 the first Master's level program was opened at Sarah Lawrence College to train a new allied health professional, the genetic associate (Marks & Richter, 1976). These individuals were necessary to assist physicians in relating genetic information to patients as the field of genetics expanded. Genetic associates, now more commonly called genetic counselors, filled the workforce gap. Genetic counseling is the process of communicating scientific information to families who are at risk for hereditary conditions which is similar to the previous hereditary clinics. In addition, the process of genetic counseling explains testing options which are now available given the advances in the field of genetics.

The most cited definition of genetic counseling is one that was agreed upon by the Committee on Genetic Counseling of the American Society of Human Genetics in 1972. The definition is as follows:

> Genetic counseling is a communication process which deals with the human problems associated with the occurrence, the risk of occurrence, of a genetic disorder in a family. This process involves an attempt by one or more appropriately trained persons to help the individual or family (1)

> comprehend the medical facts including the diagnosis, the probable course of the disorder, and the available management; (2) appreciate the way heredity contributes to the disorder, and the risk of recurrence in specified relatives; (3)understand the options for dealing with the risk of recurrence; (4) choose the course of action which seems appropriate to them in view of their risk and their family goals and act in accordance with that decision; and (5) make the best possible adjustment to the disorder in an affected family member and/or to the risk of recurrence of that disorder (Fraser, 1974, p.637).

While this is the most often used definition of genetic counseling, it is lengthy and does not completely reflect the counseling component of the practice of genetic counseling (Resta et al, 2006). Therefore, the National Society of Genetic Counselors (NSGC), the professional society for master-level trained genetic counselors, sought to create a definition that was more succinct and could be applied to many consumers of genetic counseling services. In 2003, a task force created by the NSGC developed the following definition:

> genetic counseling is the process of helping people understand and adapt to the medical, psychological, and familial implications of the genetic contributions to disease. This process integrates:
>
> - Interpretation of family and medical histories to assess the chance of disease occurrence or recurrence.
> - Education about inheritance, testing, management, prevention, resources and research.

- Counseling to promote informed choices and adaptation to the risk or condition (Resta et al, 2006, p. 79).

The above definition is thought to be more current and has the ability to be adapted to be used when presented to clients, policy makers, insurers, and several consumers of genetic counseling services. In addition, the authors of the definition contend that "the NSGC definition forms the basis for assessing the field of genetic counseling for its relevance, its usefulness in counseling practice, and its value to society" (Resta et al, 2006, p.80).

As the field of genetics has expanded, the goals of the profession have similarly changed over time. Biesecker (2001) contends that there are two primary opinions about the goal of genetic counseling. The first relates to the prevention of birth defects and genetic conditions, whereas the second refers to enhanced psychological coping and adjustment to a genetic diagnosis. In the field's infancy, in the 1970s, testing options were limited and the main focus of the provision of genetic services was to prevent the birth of children affected with birth defects; however, this viewpoint is mired in the eugenics movement rather than being based in a client-centered perspective. Therefore, in the 1980s, those who studied the field of genetic counseling recognized that there was a shift toward providing information to clients so that they can make well-informed decisions about the genetic issues facing their families. At the same time, prenatal testing became available and one of the decisions presented to families was, and continues to be, reproductive options about an affected pregnancy (Biesecker, 2001). While the option of termination of pregnancy of affected pregnancies relates back to the prevention of birth defects and is often cited as a concern about the profession, current practice does not support this as a goal of genetic counseling. Rather, one goal of genetic counseling is to

help a family/couple adapt to their situation that best fits with their culture, religion, and morals.

As the definition and goals of genetic counseling have changed over time as advancements in genetics have been made, so too have the areas in which genetic counselors practice. It is generally understood that genetic counselors provide services throughout the life cycle (Bennett, Hampel, Mandell & Marks, 2003; Ciarleglio, Bennett, Williamson, Mandell, & Marks, 2003). In its inception, master-level trained genetic counselors primarily counseled clients of higher economic status regarding prenatal testing options. However, as genetic testing has evolved from the ability to detect chromosomal anomalies *in utero* to identification of hundreds of disease-causing mutations in pregnancies, children and adults, genetic counselors work with clients of all ages. In the prenatal setting, genetic counselors help interpret findings from prenatal screening methods such as ultrasound studies or routine blood tests devised to identify at-risk pregnancies for chromosomal conditions or neural tube defects, such as *spina bifida*. Additionally, as research has identified deleterious effects of prenatal exposures to chemicals or medications, genetic counselors help clients understand the ramifications of these exposures on their fetus. According to the 2012 NSGC Professional Status Survey (2012), 29% of practicing genetic counselors work within the prenatal setting. This percentage is a 10% decrease from the 2010 Professional Status Survey and a 25% decrease from 2006. This steady decline is indicative of the evolution of the field into other areas of practice.

The second most common area of practice according to the 2012 Professional Status Survey is the field of cancer genetics with 25% reporting working in this area

(National Society of Genetic Counselors, 2012). In this setting, genetic counselors are responsible for assisting an individual to determine if he/she is at an increased risk to have a mutation within a cancer susceptibility gene, such as *BRCA1* or *BRCA2,* based on one's personal or family history of cancer. Mutations in these genes predispose an individual to an increased risk for developing breast, ovarian, or prostate cancer. As molecular genetics researchers identify those genes implicated in the development of various cancers, the role genetic counselors play in assisting individuals to determine if they desire genetic testing for susceptibility cancer genes is increasing. In addition, "genetic counselors are instrumental in working with multiple family members to help them formulate a decision that serves the family unit and not just the at-risk individual or the patient" (Ciarleglio, Bennett, Williamson, Mandell, & Marks, 2003, p. 1285). Although cancer genetics is the predominant area for practice in adult genetics, with the discovery of genes that contribute to heart disease, neurological disorders, psychiatric illness, and other adult-onset disorders genetic counselors are finding themselves working with families and physicians who are facing these conditions.

Genetic counselors have been working with families in the pediatric setting for some time, and prior to the advent of cancer genetic counseling pediatric genetic counseling was the second most common area in which to practice. However, in 2012 13% of genetic counselors reported working in the pediatric setting (National Society of Genetic Counselors, 2012). In these cases, genetic counselors work with families to help understand the reason for their child's genetic condition, especially if a diagnosis has been made; the prognosis and management issues; and provide emotional support and information about community resources (Ciarleglio, Bennett, Williamson, Mandell,

&Marks, 2003). A subset of pediatric genetic counselors work with children who screen positive on newborn screening, which may result in a child affected with one of the several conditions for which is now screened. Some of these conditions have treatment available, such as changes to diet, whereas others are not treatable. Therefore, "genetic counseling for affected children and families is integral in medical management, family planning, and emotional coping" (Ciarleglio, Bennett, Williamson, Mandell, & Marks, 2003).

Genetic counselors provide care under certain tenets which strive to embrace biomedical ethics. Specifically, master-level trained genetic counselors incorporate the principle of autonomy, under which falls informed consent, as well as a term which is used quite widely in the profession, that of "nondirectiveness." Nondirectiveness is a term grounded in the client-centered approach of counseling introduced by Carl Rogers. In 1942, Rogers described this counseling technique as

> the non-directive viewpoint places a high value on the right of every individual to be psychologically independent and to maintain his psychological integrity…In the field of applied science, value judgments have a part, and often an important part, in determining the choice of technique. (Djurdjinovic, 1998, p. 147)

This nondirective approach is applied in the genetic counseling milieu by the genetic counselor providing the information in an unbiased manner so that the counselor's biases are not divulged. The goal of nondirectiveness is to allow patients to come to their decision on their own without undue influence from the professional with whom they are interacting. In essence, the decision which is right for the genetic counselor may not be

right for the patient, and it would be unethical for the genetic counselor to potentially sway the patient's decision based on the professional's viewpoint.

As Resta (1997) points out, many genetic counselors believe that nondirective counseling is the profession's way of practicing in a manner which is the antithesis of eugenics. However, the founding fathers of the field of genetic counseling advocated nondirective counseling while at the same time supporting eugenics practices. The main issue geneticists had with eugenics movements were that they were "based on racism and coercion;" however, the overall principle of eugenics was "compatible with the goals of genetic counseling. Nondirectiveness was a reaction to the methodology of eugenics, not its principles" (Resta, 1997, p. 256). Even Fraser in 1974 questions the appropriate degree of directiveness provided by a genetic counselor and contends that most genetic counselors find a balance between simply presenting information and telling a client how to proceed in a given situation. As he states, "most counselors would refrain from directly telling a counselee what to do" but that the majority of genetic counselors would assist the counselee in weighing the various factors that should be considered when making a decision (Fraser, 1974, p. 649). However, some in the field question whether nondirective counseling is actually possible to achieve and whether the principle of nondirectiveness should define the practice of genetic counseling.

In addition, as the field of genetic counseling continues to evolve some question whether nondirective counseling is even appropriate. As Bennett, Hampel, Mandell and Marks (2003) state "the traditional dogma that genetic counseling must be nondirective is being challenged in favor of a psychosocial approach that emphasizes shared deliberation and decision-making between the counselor and the client." There are instances when

nondirective counseling is ineffective and it is more appropriate for a clinical or ethical recommendation to be made. For example, when a specific test or treatment is needed to diagnose or to treat a condition, the genetic counselor may need to make a clinical recommendation. There are many ethical situations that can arise in genetic counseling, such as testing a minor for a late-onset genetic condition, and these situations may require a genetic counselor to make an ethical recommendation. In either circumstance, nondirectiveness may not be the best approach. Instead, Elwyn, Gray and Clarke (2000) suggest that a shared decision making approach may be better. With this strategy, the two parties involved, in this case the client and the genetic counselor, both share information about the decision at hand. The end result is a decision made that both parties agree upon after both have had an opportunity to share information. Shared decision making is client centered which still upholds the Rogerian philosophy; however, it allows a genetic counselor to provide a more active role in the decision making process than true nondirectiveness. Thus, while the field of genetic counseling continues to evolve and matures, its roots remain grounded in client centered care which will likely continue to be the underlying philosophy of the field. However, as Fraser (1974) aptly stated during the infancy of the profession "training in the general techniques of counseling would be a useful part of the training of a genetic counselor" (p. 650).

Although the practice of genetic counseling dates back to the 1940s, formal practice did not occur until the 1960s. Subsequently, formal education of those individuals who are now called genetic counselors began in the 1970s. The training of genetic counselors goes back 40 years and is complex given the nature of the field drawing from both the medical and psychological fields. Great strides have been made to

ensure that future genetic counselors have the breadth of knowledge required to practice in an ever-changing field within healthcare. While the education and areas required to achieve competency are well-laid out for genetic counseling trainees, there has been little research into how these individuals are educated.

Education in Genetic Counseling

A search of the literature revealed only a few articles related to education of genetic counselors. While there are several publications regarding genetics and education, the focus is not on the training of the professional but rather how the professional educates the client about genetics information (Bedard, Huether, Shooner, Buncher &Warren, 2007; Stein, Fine & Pergament, 1994; Weil & Mittman, 1993). The majority of the articles which pertain directly to the training of master-level genetic counselors are historical perspectives of the development of the competencies which were adopted by the accrediting body, The American Board of Genetic Counseling, which began to accredit genetic counseling training programs in 1992 (Fiddler, Fine, & Baker, 1996; Scott, Walker, Eunpu, & Djurdjinovic, 1987).

Two articles provide insight into the creation of graduate training for genetic counselors. The first by Scott, Walker, Eunpu, and Djurdjinovic (1987) describes the history of the developments related to genetic counseling training programs. The authors provide details regarding ideal components of curricula as determined during three critical meetings held during 1974 and 1979. The authors describe the lack of accreditation at that time for genetic counseling training programs which may have an impact on the effectiveness of training and ability to pass the professional certification examination. Lastly, the authors describe the requirements for continuing education for

genetic counselors. Admission requirements are also reviewed for the twelve master-level genetic counseling programs which were in existence at the time of the writing of that article. The authors showed foresight as they considered future issues facing the profession, such as the need for additional programs based on the job market for genetic counselors. In addition, professional issues are contemplated, such as obtaining licensure, maintenance of continuing education, and career advancement.

In 1990, Walker, Scott, Biesecker, Conover, Blake, and Djurdjinovic provide a historical perspective of the creation of the genetic counseling training program. The authors summarize the conclusions from four workshops which were held in 1989 to determine guidelines for genetic counseling master degree training programs. From the workshops, the content of didactic training was established and that training should encourage life-long learning. Seven major areas were identified as critical to the training of genetic counselors, each consisting of several subtopics. The requirements for clinical training were determined which included primary involvement in at least 50 cases or 400 contact hours. One workshop debated the issue of doctoral degrees for genetic counselors and weighed the pros and cons of this degree in the field of genetic counseling which at the time was not an option. Workforce issues were also summarized since there were relatively low numbers of genetic counselors in the field at that time. However, there is no mention of how best to teach students enrolled in these programs and no teaching techniques are considered.

While these articles provide a historical viewpoint into the creation of genetic counseling graduate programs, a few have focused on the content that is included in the programs. Biesecker, Vockley, and Conover (1993) reported on the implications that

developing genetic technologies may have on training of genetic counselors and the importance of incorporating such developments into genetic counseling graduate training programs. They describe four areas in where programs should focus which include: human variation and diversity, genetic discrimination, potential new threats to nondirectiveness, and genetic screening implementation and policy development. Recommendations for inclusion into curricula for each area are presented. The authors recognize that the program directors face the challenge of training future professionals in a field which is continually changing; however, the authors do not provide suggestions for integrating new information into curricula.

In 1993, Smith (1993) reported on a survey of curriculum content in master-degree training programs in genetic counseling. Her study was conducted in 1991 at which time there were 17 training programs. The number of "actual contact hours" was obtained for both didactic coursework and clinical field experience. Didactic coursework was divided into two categories: basic science and behavioral science and counseling, whereas fieldwork was divided into clinical practicum and laboratory practicum. Results from the study revealed an average of 1349 actual contact hours in the programs which are typically two years in duration. Fifty-eight percent of time was spent in clinical experience, 21% in didactic learning related to basic science, and 16% in didactic learning related to counseling. A few programs spent an additional 5% of time in laboratory practicum. This article compares its findings to a similar, unpublished study conducted in 1989. The author reported that there were increases in every area including 23% in basic science, 82% in psychosocial issues, 10% increase in clinical practica and the overall time spent in contact hours in these programs increased by 25%. While this

article presents a breakdown of how much time is spent in hands-on clinical training versus didactic learning, there is no description of how that didactic learning is occurring.

As the field evolved, so did the training programs. As such, it became clear that there should be a defined set of skills that genetic counseling trainees should acquire during their training. Fiddler, Fine, and Baker (1996) describe the process of developing practice-based competencies (PBCs) for the field of genetic counseling. The need for PBCs was derived when a new accrediting body, the American Board of Genetic Counseling (ABGC), was established in 1993. The ABGC accreditation committee assembled a Consensus Development Conference in 1994 to establish PBCs for genetic counseling training. They employed a "case-based, narrative process" which enabled the participants to identify competencies which would be needed to handle real-life, professional encounters. Once the initial competencies were identified, these were further refined and resulted in 27 core competencies within four domains.

In a subsequent article, Fine, Baker, and Fiddler (1996) elaborate on the outcomes of Fiddler, Fine and Baker (1996) regarding the development of practice-based competencies (PBCs) for the field of genetic counseling. The four domains and 27 overall competencies for which an entry-level genetic counselor should be able to demonstrate are described. The four overarching domains are: communication skills; critical-thinking skills; interpersonal, counseling, and psychosocial assessment skills; and professional ethics and values. Within each domain there are several skills delineated which should be achieved in order to exhibit competency in that particular domain. The authors stated these PBCs will become the criteria used for program accreditation; however, each program will be able to incorporate the PBCs in their own unique manner.

Incorporation of the PBCs should occur in all facets of training - didactic, clinical experience, laboratory activities, and other adjunct learning activities (e.g. journal club, grand rounds, case conferences).

A few articles have been written about the supervision aspect of the profession; however, these articles are not in reference to how a training program teaches supervision skills. Of the articles which evaluate genetic counseling training programs, the authors focus on one particular aspect of training. For example, Bedard, Huether, Shooner, Buncher and Warren (2007) describe the exposure genetic counseling trainees receive surrounding research. The authors examined the training genetic counseling graduate students receive related to research, as well as the level of interest genetic counselors have to conduct research. To assess the training provided, program directors from genetic counseling graduate programs were surveyed. It was found that the majority of programs utilize a thesis project to teach research methodology; however, other programs teach research through didactic courses or independent study. The second part of this study surveyed genetic counseling students and their perceptions of how much research is incorporated into their curriculum. Those students enrolled in a program with a thesis requirement felt better prepared to conduct research in the future compared to those who did not need to complete a thesis project. Many of the students responded that they would be interested in performing research upon graduation; therefore, the authors conclude that training programs should enhance research education. However, the authors do not address how this education should be conducted.

Stein, Fine and Pergament (1994) detail how one training program teaches its students to provide teratogen (fetal effects from chemical agent exposure) counseling.

The program incorporates teratogen training into all facets of the program including both didactic and experiential fieldwork. One five-week rotation was created as part of a student's graduate training to expose the student to many facets of teratogen counseling. Students are expected to participate in journal clubs pertaining to teratogen issues to further enhance their learning. While this article addressed an experiential learning opportunity, there is no adult learning theory presented and is mainly a descriptive article.

A few articles in the literature address the issue of teaching cross-cultural competence. Wang (1998) accounts her experience in creating a specific curriculum aimed at increasing multicultural awareness, whereas Weil and Mittman (1993) describe components necessary for a program to succeed in teaching its students about cross-cultural issues. Wang (1998) conducted a quantitative study that evaluated genetic counseling trainees' multicultural competence pre- and post- exposure to a multicultural curriculum. Subjects completed the Multicultural Awareness-Knowledge and Skills Survey (MAKSS) in either their first or second year of graduate school training to determine if timing of when the curriculum had an impact on cross-cultural competence. Results indicated that first year students had a statistically significant increase in cultural awareness compared to the second year students. There was no statistically significant difference in scores on the MAKSS for presenting the materials in the beginning or end of one's training. Therefore, the author contends that the curriculum devised to enhance cross-cultural competence for genetic counseling students is successful and it does not matter when the information is taught, only that it is incorporated into a program's curriculum.

Weil and Mittman (1993) add to the growing literature regarding teaching cultural competency specifically related to the field of genetic counseling. In order to enhance a training program's curriculum to increase cross-cultural competency, they propose four components to include: consideration of the multicultural aspects of all psychosocial issues, information about specific cultures and groups, fieldwork training, and self-awareness and countertransference. The authors state that learning cross-cultural issues is not solely the responsibility of the program, but that the student should engage in life-long learning and "self-exploration."

Thus, while there are a handful of articles which pertain to the education of genetic counselors, many of these are descriptive in nature. There are no articles which describe learning styles, satisfaction, or effective teaching mechanisms for those enrolled and involved with genetic counseling training programs. Similarly, the literature in this specific field does not address genetic trainees as adult learners and has not explored issues that relate to these learners. While graduate students are adults by nature of their chronological age, there are other characteristics that define adult learners such as returning to school to make a career change, delaying enrollment in higher education, being a single-parent, or having other financial responsibilities. These adult learners have been categorized as non-traditional students. Although it is unknown how many genetic counseling trainees would be considered non-traditional students, there are certain characteristics that define all adult learners. One such trait is that adult learners have the motivation to master knowledge in a specific area in order to achieve a specific goal. For genetic counseling trainees, this goal is to become proficient in the field of genetic counseling in order to practice their chosen career. To this end, thinking about genetic

counseling trainees in the context of adult learners could alter how these students are being educated and it would behoove instructors involved in the genetic counseling training programs to be cognizant of the concepts derived from the field of adult learning.

Adult Learning Theories

Theories related to how adults learn are abundant; however, the theories can be divided into four areas which include self-directed learning, experiential learning, critical reflection and how learners learn (Brookfield, 1995). In the first model, self-directed learning, the adult learner is responsible for acquisition of information and is responsible for doing so at his or her own pace. In addition, the learner is responsible for evaluation of the learning process and to identify which resources are needed to achieve defined goals. Second, experiential learning focuses on the role experiences have on the learning process and that the accumulation of experiences leads to acquisition of knowledge. According to Brookfield (1995), critical reflection is comprised of three interrelated processes (1) by questioning and reorganizing ideas which have been assumed to be correct; (2) by taking an alternate stance about a previously held concept; and (3) by recognizing the cultural dominance of values and how that can actually help promote issues related to minorities. Others classify this category as transformational learning (Merriam, Caffarella,& Baumgartner, 2007). Lastly, understanding that adults vary their ability to learn in different situations has become an area of research. Having an understanding of adult learning theories is important for educators involved in higher education so that the classroom is conducive to the adult learner and teaching modalities employed are consistent with the psychological underpinnings of the adult learner.

Theory of andragogy. One of the oldest theories of adult education is Knowles's concept of andragogy. This concept stemmed from the realization that adults did have the potential to learn; however, their needs were different than children (Merriam, 2001). Initially Knowles based his model on four assumptions: (1) one's personality becomes less dependent and develops into a self-directed person; (2) a person builds on his/her collection of experiences which acts a resource for learning; (3) the motivation to learn is based upon a social readiness; and (4) there is a sense of timeliness that is not seen previously, in that what is being learned now is applicable to one's current situation, thereby having an increased sense of requiring the knowledge in order to perform a task or job (Knowles, 1988). Later on, Knowles added two more assumptions: (1) internal motivators are more critical than external motivators and (2) there needs to be relevance as to why they are learning (Merriam, Caffarella, & Baumgartner, 2007).

In addition, Knowles also set forth ideals pertaining to the way adults learn. These include that the physical environment should be one which reflects the sense that adults are the students. For example, the chairs should be sized appropriately to an adult body habitus rather than a child's. In addition, the adult learner and the instructor may have more of a collaborative relationship as they are often of a similar age and at times the student may be older than the instructor. Therefore, there is a need for mutual respect between the adult learner and instructor. Lastly, because adult learners are assumed to be responsible individuals, they can also take responsibility for their learning and can participate in the direction and/or planning of their learning (Merriam, 2001).

Initial criticism of Knowles' theory was based on the fact that these assumptions are specific to andragogy and that pedagogy is grounded in other assumptions; however,

critics believe these assumptions are not specific to adults. Therefore, Knowles later stated these assumptions are on a continuum from childhood to adulthood. However, further criticism has ensued as to whether the assumptions constitute a theory but rather should be considered a framework (Merriam, Caffarella, & Baumgartner, 2007).

Transformational theory. Jack Mezirow used concepts put forth by Kuhn (1970), Friere (1973/1981), and Habermas (1981/1984) in creating his theory which "is the process of affecting change in a *frame of reference" (*Mezirow, 1997, p. 5). Kuhn addressed modification of new ideas from the standpoint of research; however, his thoughts revolved around the fact that "crises are a necessary precondition for the emergence of novel theories" which can be applied to one's experiences (Kuhn, 1970, p. 77). A principle idea of Mezirow's theory is the concept of frame of reference which refers to "structures of assumptions and expectations that frame an individual's tacit points of view and influence their thinking, beliefs, and actions" (Taylor, 2008).

According to Mezirow, these frames of references allow us to make sense out of new experiences and are based on assumptions made by previous experiences. Transformational learning occurs when learners move toward a frame of reference that is more inclusive, discriminating, self-reflective, and integrative of experience" (Mezirow, 1997, p. 5). There are two major components of transformative learning: critical reflection and critical discourse. "Critical reflection is the means by which we work through beliefs andassumptions (Cranton, 2002, p. 65). As Friere wrote, "men relate to their world in a critical way. They apprehend the objective data of their reality…through reflection – not by reflex, as do animals" (Friere, 1973/1981, p. 3). His stance of critical thinking related to social issues and democracy; however, he believed "a person must

make his own [positions, attitudes] by intervention in and integration with his own context" (Friere, 1973/1981, p. 19). Habermas described different types of discourse that allow a person "to expose themselves to criticism and, if necessary, to participate properly in argumentation." As he stated, "argumentation plays an important role in learning processes"(Habermas, 1981/1984, p. 18). Furthermore, Mezirow stated "discourse allows us to test the validity of our beliefs and interpretations" (Mezirow, 1996, p. 165).

Since critical reflection is a concept of transformative learning, Taylor (2008) states that educators should incorporate ways of introducing critical reflection into the classroom. Examples of how this can be accomplished include critical questioning, journaling, and interactive discussions. Students must be challenged in order for critical reflection to occur. However, educators must be cognizant of a learner's ability and willingness to change.

Concept of critical reflection. Brookfield states there are two assumptions made regarding adult learning: (1) adults are self-directed learners and (2) learning satisfies one's desire for self-actualization (Brookfield, 1985). Similar to Mezirow's theory, there is a critical reflection which takes place regarding the context of one's learning. With self-reflection comes the understanding that change can happen. Thus, critical reflection is a major component of transformational learning (Mezirow, 1998).

According to Brookfield, "the purpose of critical thinking tends to be to scrutinize two particularand interrelated sets of assumptions" (Brookfield, 1997, p. 18). Assumptions are created in our minds because we may have taken information for granted or trusted our initial source of the assumption, and these assumptions are often

not questioned. However, Brookfield believes that we should question both power relationships, as well as hegemonic assumptions. "Uncovering and questioning these power relations so that we might redirect the flow of power in a circular or democratic manner is an important part of critical thinking" (Brookfield, 1997, p. 18). Hegemonic assumptions are those that we think act in our best interest, but this may not always be the case. Thus, questioning both sets of assumptions allows one to be emancipated and be free in our thinking. There are three interconnected steps that need to take place in critical reflection, (1) the questioning of a previously held assumption and reframing that assumption; (2) taking a different perspective about a previously held ideology; and (3) recognizing the hegemonic ideals within one's culture (Brookfield, 1995).

Brookfield further expounded on his critical theory of adult education in his book, *The Power of Critical Theory: Liberating Adult Learning and Teaching* (2005). He proposed there are seven adult learning tasks that encompass his critical theory. The first is challenging ideology which relates to what is described above regarding how adults must assess and resist commonly held ideals. According to Brookfield, ideology is the "broadly accepted set of values, beliefs, myths, explanations and justifications that appears to be self-evidently true, empirically accurate, personally relevant, and morally desirable to a majority of the populace" (Brookfield, 2005, p. 41). Questioning ideological stances includes those principles that pertain to policy, as well as to civic institutions and social networks. Thus, there is an underlying sense that critical theory seeks toexamine social inequities and oppression. The second task is contesting hegemony; however, Brookfield expands on this idea to take account those hegemonic concepts that are created by the entertainment industry and the media, as well as

considering the role global economy plays in our thinking. Lastly, Brookfield contemplates hegemony in the context of power. Since hegemony is central to ideology, Brookfield states "a critical theory approach to adult learning should help us understand how adults learn to recognize hegemony in the beliefs and assumptions they live by and the structures they live within" (Brookfield, 2005, p. 46).

The third learning task within critical theory follows the concept of power and is unmasking power. According to Brookfield, and other adult learning theorists, a pivotal role for the adult learner is to recognize the areas of power we encounter in our lives and gain an understanding of how these power relationships are used. Additionally, one of the notions of Brookfield's critical theory is that of self-directed learning and it is important to appreciate how power plays a role with self-directed learning. In order for self-directed learning to occur, the individual must "exercise power and control over their own educational activities" (Brookfield, 2005, p. 49). Overcoming alienation is the fourth task which deals with recognizing to live freely and to foster a sense of freedom to pursue one's desires even when contrary to the majority. Learning liberation, the fifth task, relates to the need for the individual to break from the collective whole. As Brookfield states, "accelerated learning programs that emphasize self-paced learning, individualized programs of study, or online instruction are raising the chances that learners might possibly experience the degree of separation from the mainstream body of learners" that would allow for subjective questioning (Brookfield, 2005, p. 55).The sixth task is reclaiming reason which pertains to the notion that we must use reasoning in all aspects of our lives, not just when technical decisions are being made. The seventh and final task is practicing democracy. As there are social undertones to critical theory, it stands to

reason that democracy would be central to the theory. Some of the democratic ideals put forth include appreciating diversity, recognizing there are multiple facets to decisions, recognizing the role social institutions within the context of democracy, and appreciating we are often faced with mutually exclusive options that we must question. Many of these seven tasks are grounded in a social context by asking the individual to take a step back and critically reflect on the world around them although this may not be an easy undertaking. Therefore, the educator has a role to play in assisting the adult learner to achieve these tasks.

Critical to adult learning is the concept that the learner must become empowered and possess a sense of self-esteem in order to benefit from adult education. Thus, it is the educator's responsibility to instill these feelings so that the adult learner develops a sense of control and autonomy (Brookfield, 1985). Brookfield defines six principles of critical practice for adult education: (1) participating in learning is not mandatory; (2) self-worth must be stressed; (3) teachers and learners are collaborators; (4) learning is dynamic (praxis); (5) critical reflection needs to occur; and 6) empowerment and self-direction are the outcomes of learning (Brookfield, 1985). Adult educators have a responsibility to engage and facilitate learners in meaningful learning experiences in order to allow critical reflection to occur (Mezirow, 1998).

These above principles are echoed in practice-based learning as inherent to this learning theory is that learners need to be self-directed and reflective in order to determine what they know and where their learning needs to go. Self- directed learning includes three aspects: planning, monitoring, and evaluating one's learning. In the planning phase, the learner sets goals and how to achieve these goals and think about

what may hinder accomplishing these goals. During monitoring, the learner is cognizant of what is presently occurring and what is next. However, the evaluation phase is the one most related to critical reflection learning as reflection occurs in the context of whether learning goals were achieved. In addition, self-regulation and knowing what motivates oneself as a learner occurs in this phase (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005).

Experiential learning. There are many interpretations of what constitutes experiential learning; however, most believe that the concept is grounded in learning that is not taught in the traditional sense of the word (Illeris, 2007). According to Illeris (2007), in order for learning to be experiential,

> learning processes and outcomes must be part of processes of continuity and interaction, they must, at least to some extent, be learner controlled and involve the learner's self, and there must be some correspondence of the learning environment to real environment (p. 86).

In addition, there is an emancipatory nature to experiential learning that allows for freedom of discovery, as well as self-direction. Illeris has developed a model called the *Three Dimensions of Learning* which is grounded in experiential learning. In order for learning to occur, there is a requisite interaction which takes place internally, which is comprised of cognition and emotion, and then externally which is influenced by interaction of environment (Illeris, 2007). All of this takes place within the context of society. Thus, content and incentive are paradigms which work together toward acquisition for the individual. This is then impacted by interaction all of which is influenced by the environment within a social context. There are five stimuli which

promote learning: perception, transmission, experience, imitation, and participation (Merriam, Caffarella, & Baumgartner, 2007). This theory follows others in that acquisition of new information is built upon past information or experiences. Because of this, Illeris concludes there are three dimensions to learning which include cognition, emotion and society.

One of the best known theories of experiential learning is that of Kolb's. There are four facets to Kolb's theory which is grounded in experiential learning. To be effective, there are four kinds of abilities: (1) concrete experiential abilities (CE) – one involves fully without biases to new experiences; these individuals are open to try new things; (2) reflective observation abilities (RO) – one is able to reflect on and observe experiences; individuals can appreciate varied perspectives; (3) abstract conceptualization abilities (AC) – one creates concepts and can integrate observations into theories; and (4) active experimentation abilities (AE) – one uses theories to make decisions and problem solve. These concepts are interrelated to each other and are cyclical in nature (Kolb, 1984; Merriam, Caffarella, & Baumgartner, 2007).It is purported that an individual needs to experience the whole cycle, albeit at different times and pace, in order to achieve learning.

Experiential learning is key to problem-based learning (PBL) as the use of cases or problems creates context or an experience that can enhance learning. Additionally, PBL stimulates learning by provoking past experiences and knowledge which allows for active learning. Further elaborating on the contextual aspect of PBL, the presentation information from varied perspectives allows for the transfer of information and fosters flexibility so that the information can be applied to different situations. This context

allows the learner to think about experiences from practice and apply this to their own practice (Dolmans, de Grave, Wolfhagen, & van der Vleuten, 2005).

The above concepts relate to how an adult learner acquires knowledge based on their level of maturity that is not seen in juvenile learners. These theories were developed subsequent to the learning theories that were put forth by psychologists. While there are several learning theories, the majority of the adult learning theories are rooted in the constructivist learning theory which focuses on how individuals make meaning from their past experiences while recognizing there are both endogenous and exogenous factors at play. Since the constructivist learning theory encompasses many aspects from the core learning theories, having an understanding of these learning theories can assist those working with adult learners.

Learning Theories

It has been well established that learning is considered to be a process that is influenced by several factors. These factors are psychological, cognitive, emotional, and environmental which interact to influence how learning occurs through acquisition of information, skills, and morals. Many of these theories are grounded in the works of psychologists and social scientists and several theories have been proposed. However, there are five perspectives which are the most commonly referred to and include: humanism, cognitive, behaviorism, constructivism, and social learning. Each perspective takes a different viewpoint and has specific guiding principles.The study of how individuals learn is important for those in the field of education as these theories enhance the understanding of the intrinsic and/or extrinsic factors that motivate learning.

Additionally, educators typically prescribe to one or more perspective which influences how they teach students.

In the humanist orientation, the motivation for learning comes from the individual's innate desire to grow and develop. There is a holistic approach in this perspective recognizing the person as a whole who is in control of his/her personal growth outcomes (Marquardt & Waddill, 2004; Smith, 1999). Theorists who influence this perspective include Maslow (1970) and Rogers (1983) and embrace concepts of self-actualization, self-directed learning, and experiential learning. Maslow (1970) believes that the motivation for learning is based on satisfying one's innate and basic needs and the learner will "do anything necessary to achieve these goals" (p. 63). For Rogers (1983), learning that engages the individual on both an emotional and a cognitive level is more beneficial rather than rote memorization. Learning activities that are grounded in experience and are self-initiated are requisite factors for effective learning.

The cognitive orientation is grounded in determining how individuals make meaning and how they learn from comprehending how one understands, processes and retains information. Those who influence this perspective include Köhler (1929), Bruner (1965), and Lewin (1951). This theory recognizes the roles experience and environmental factors have in the learning process; however, the learner is the locus of control rather than extrinsic factors dictating the learning process (Smith, 1999). Cognitive psychologists recognize that learners are not passive but rather are active in the learning process (Shuell, 1986) and it is the shift to the individual that characterizes this viewpoint of learning. The most well-known perspective within this learning theory is the Gestalt perspective which is characterized by the understanding that "you can only

know that which you experience" (Melnick, 1997). According to Köhler (1929) and *gestalttheorie,* "the processes of learning, of reproduction, of striving, of emotional attitude, of thinking, acting … may be included as subject matter … as they do not consist of independent elements, but are determined in a situation as a whole" (p. 193).

Lewin (1951) outlined four aspects of change which define learning. These are: (1) altering knowledge or cognitive structure; (2) a change in motivation either in the positive or the negative; (3) learning by identifying with a group by gaining a sense of belonging or philosophy; and (4) adapting one's body in order to gain new skills. Changes in structure can be based in reality or be based on self-imposed psychological functions, such as fears or desires. In addition, cognitive changes are psychologically impacted by three temporal points, the past, present or future. Development occurs when undifferentiated regions become differentiated. All changes in schema are influenced by some type of force; changes which are grounded in the person's interests or needs or based on others' needs which is more passive. Bruner described learning as a process of discovery and in order for this to occur, educators' goal "is to give [the] student as firm a grasp of a subject as [possible], and to make him as autonomous and self-propelled a thinker as [possible] – one who will go along on his own after formal schooling has ended" (Bruner, 1965, p. 608). This is the very definition of life-long learning and exemplifies the individualistic and experiential nature of cognitive learning.

In contrast, the behaviorist perspective focuses on the influence environmental factors have on the learning process. The individual is expected to adapt and change his/her behavior in order to learn. Well-known theorists who contributed to this orientation include Skinner (1954), Pavlov (1957), and Watson (1930). Watson likened

behaviorism to the field of physiology in that there is a cause and effect for everything. Behaviorists want to influence and control other's responses by manipulating stimuli (Watson, 1930). One of the best known behaviorists is Pavlov who is known for his physiological experiments with animals. Interestingly, during a speech in which he criticizes Gestalt psychology, Pavlov succinctly sums up learning from the behaviorist perspective. He stated "all learning consists in the formation of temporary connections, and it is this which constitutes thought, thinking, knowledge" (Pavlov, 1957, p. 581). He elaborated in that a connection is often an "unconditioned reflex, an inborn instinctive connection" that causes an association with a behavior which results in knowledge or thinking. (Pavlov, 1957, p. 583). One well known concept related to behaviorism is operant conditioning, for which Skinner is best known. The desired behavior initially occurs by chance and is reinforced which strengthens the wanted behavior and the "behavior is said to be *strengthened* by its consequences" (Skinner, 1974, p. 40). According to behaviorists, in order to learn individuals need to be exposed to repetition and reinforcement (Marquardt & Waddill, 2004; Smith, 1999).

Social learning or social cognition is based on the fact that people learn from observations and relationships with others in a social context. Additionally, learning occurs through imitation, such as mentoring or apprenticeships. Community of practice and organizational culture are also concepts which fall into this theory of learning. Bandura's (1986) work heavily influences this perspective. "Bandura maintains that cognition involves knowledge and the skills for acting on that knowledge" (Grusec, 1992). Thus, Bandura believes there are four concepts that lead to acquisition of knowledge: modeling or observational learning, individual control that leads to self-

efficacy and self-regulation, and lastly, reciprocal determinism which is how the individual interacts with one's environment and one's behavior (Grusec, 1992). Bandura (1986) contends that modeling begins in infancy as a child models a parent's behavior. This modeling continues throughout childhood as it motivates both the child and parent; the child gains security from the parental interaction and the parent is rewarded with the child's gains in skills. Self-efficacy is an important concept for learning as it one factor that allows the learner to persevere. "Perceived self-efficacy is a judgment of one's capability to accomplish a certain level of performance" (Bandura, 1986, p. 391). According to "the social cognitive view, persons are active agents who exercise some influence over their own motivation and actions" (Bandura, 1986, p. 255). Therefore, one's behaviors are controlled through one's self-regulatory functions which are influenced by several motivational factors. Social learning theory recognizes that the while the individual is the central figure there are external forces that are grounded in social relationships as well as internal forces that influence the individual's learning.

Constructivism. The final perspective, constructivism, is a compilation of all of the previous orientations. Its focus is on how individuals make or construct meaning from their experiences and is still grounded in intrinsic forces and motivation. In addition, learners take an active role in their learning (Boghossian, 2006). Concepts which are included in this theory include critical reflection, communities of practice and situated learning. Since the individual is at the center of this theory, "what is knowledge to one individual may not be knowledge to someone else, because no two people necessarily have the same constructions" (Boghossian, 2006). As everyone has different

life experiences and backgrounds, there is no one reality; therefore, meaning is individualistic.

Theorists who have impacted this orientation include Dewey (1938), Kuhn (1970), and Piaget (1972) (Marquardt & Waddill, 2004; Merriam, Caffarella,& Baumgartner, 2007). Dewey was one of the earliest theorists to recognize the importance experience has in learning. As he stated "what [an individual] has learned in the way of knowledge and skill in one situation becomes the instrument of understanding and dealing effectively with the situations which follow" (Dewey, 1938, p. 44). This concept is also reflected in Piaget's work. According to Piaget, we learn by accommodation and assimilation. We learn new concepts by incorporating them into already existing schemas or frameworks in one's mind, this is the process of assimilation. However, if a new idea or experience presents itself that does not fit well into an existing schema, either a new schema needs to be developed or a schema needs to be modified, this is the concept of accommodation (Cakir, 2008).

Aside from Piaget, one of the more prolific theorists within the field of constructivism is von Glaserfeld. He stated that constructivism has two critical principles. First, individuals "develop attitudes towards their experience because they like certain parts of it and dislike others" (von Glaserfeld, 1995, p. 113). Thus, the acquisition of knowledge is goal-oriented and serves to positively reinforce pleasurable experiences and avoid non-likeable experiences. Second, "knowledge does not constitute a 'picture' of the world" (von Glaserfeld, 1995, p. 114). Knowledge relates to how the individual has developed to belong to the world as he or she experiences it. Therefore, von Glaserfeld believes that teaching should be grounded in reflective abstraction which is "operating

mentally in a way that happens to be compatible with the perceptual material at hand" (von Glaserfeld, 1995, p. 184). While concrete tools are helpful in illustrating a point, these tools or physical materials also need to serve an opportunity to reflect and abstract to enhance learning. Subsequently, these abstractions are individualized as each student has a different perspective. Given that an individual's learning is specific to them, von Glaserfeld believes teachers have a responsibility to determine how each learner thinks and how the learner makes meaning. This, in turn, will foster the learner's education and acquisition of knowledge. Additionally, in order to create an arena in which reflective thinking can occur, a teacher needs to be open and probing, to listen to the students, and to create an atmosphere where sharing thoughts between student and teacher, as well as among fellow students is encouraged (von Glaserfeld, 1995). Many of these same concepts put forth by von Glaserfeld are echoed in the principles of adult learning theory.

Learning theories describe the psychological underpinnings of *why* individuals learn, as well as the intrinsic motivators and processes that lead to integration of knowledge. In addition, the various learning theories purport that the end result of learning is defined differently. For example, humanists believe the goal of learning is to satisfy an internal need; learning for a behaviorist is achieved once a behavior is changed; and from the cognitive perspective, learning occurs when a person changes a previously held concept when presented with new information. Constructivists focus on ones' individual experiences and how these experiences make meaning for the individual. Out of the concepts from constructivism and adult learning theory, practice-based learning has evolved. This manner of education recognizes the importance of self-directed learning, intrinsic motivation, critical reflection and experiential learning.

Practice-Based Learning

Theoretical framework. Practice-based learning (PBL) is rooted in the constructivist rationalist theory of learning. Teaching models which incorporate this viewpoint recognize that learning occurs endogenously and is a process which is continually developing. Teaching modalities are based upon one's natural tendency to explore and engage in "guided discovery." Exogenous factors also play a role in learning in relation to the rate of acquiring cognition; however, the internal factors are the main driving forces (Case, 1996). However, the constructivist view developed out of the field of child education and not adult education.

Much of adult learning theory is built upon the concept of self-directed learning and "self-diagnosis" (Knowles, 1988). Knowles describes a three stage process related to self-diagnosis which includes: (1) create a "model of competencies" which exhibits the desired characteristics or behavior which will allow the adult learner to model the optimal traits, (2) allow an opportunity for the adult learner to assess their current level of knowledge and (3) provide an opportunity to identify the gaps in current knowledge and desired outcomes so that a plan can be devised to achieve the intended goals. Many of the PBL curriculum described in the articles that follow adhere to this process of self-diagnosis or guided discovery as this is a hallmark of PBL.

PBL is grounded in experiential knowledge and often uses small-group discussions as demonstrated in the following articles. This contextual learning approach is parallel to the constructivist viewpoint of learning and teaching. Using the learner in the process of learning is vital to adult learning, all of which follow the constructivist approach to teaching (Imel, 2000). Therefore, by the very nature of the topic, the

following articles are consistent in which theoretical perspective is followed; specifically they adhere to the constructivist theory of learning.

Success of programs that utilize PBL techniques is well-documented as is demonstrated in the following section. This outcome is not surprising when one considers adult learning theory. Adult learners can be self-directed in their learning and can engage in a deeper level of learning than what is often experienced by children. Adults have the capacity to take knowledge that is learned in one context and transfer it to another context. Adults also have the ability to identify and assess areas of competence that may be lacking and understand they are responsible for improving that skill. Thus, adults engage in self-guided discovery in order to enhance their knowledge. The nature of PBL inherently incorporates these learning strategies; therefore, PBL is a natural fit for adult learners, especially those enrolled in graduate programs as these students typically have demonstrated previous academic success.

Effectiveness of practice-based learning in health care education. Given the paucity of research conducted specific to the field of genetic counseling teaching modalities, one may be able to apply the outcomes demonstrated in the literature related to medical school training to the genetic counseling field. Incorporation of practice-based learning (PBL) into medical schools and continuing medical education (CME) programs has increased over the past several years. The reason behind the increase is based upon the fact that PBL is one of six required competencies for medical residents as deemed by the Accreditation Council for Graduate Medical Education (ACGME) (Accreditation Council for Graduate Medical Education, 2007). In addition, the American Board of Medical Specialties (ABMS) is requiring this mode of learning for CME for

practicing physicians (Leist & Pennington, 2003; Moore & Pennington, 2003). Practice-based learning is rooted in the idea that residents and physicians are continually learning how to improve the services they provide to their patients. This method of learning is also more self-directed as is often the case in adult education as noted by adult education theorists, such as Lindeman, Knowles and Houle (Manning, 2003).

Several studies have been conducted to determine the effectiveness of PBL in medical school training. A study by Curtis, Indyk and Taylor (2001) investigated the level of student satisfaction on clerkship when PBL teaching is used, as well as increasing students' knowledge as demonstrated on a standardized examination. PBL was incorporated into the pediatric rotation curriculum only, thereby allowing comparison with the internal medicine curriculum which did not utilize PBL teaching. Student scores on pediatric subject and internal medicine subject examinations were compared for years prior to and after implementation of PBL. Students performed better on the pediatric section after the introduction of PBL compared to the internal medicine section. In order to assess student satisfaction, the subjects completed a questionnaire which used a 5-point Likert scale. The results of the questionnaire indicated that students reported increased satisfaction of PBL compared to traditional lecture-based teaching.

Enarson and Cariaga- Lo (2001) evaluated the effects of WakeForestUniversityMedicalSchool's two curriculums: problem-based Parallel Curriculum and lecture-based Traditional Curriculum. Mean student performance on the United States Medical Licensing Examination (USMLE) Step 1 and Step 2 examinations were compared between students enrolled in the two curricula.These examinations allow one to demonstrate competency and successful passage is required for licensure in the

United States. Mean scores were greater for those students enrolled in the Traditional Curriculum compared to those enrolled in the Parallel Curriculum in the seven years scores were studied; however, the results were not significantly different. The study also found that students in the Parallel Curriculum performed just as well on a standardized examination compared to students in the Traditional Curriculum. They speculate that although there were no significant differences between the two curriculum groups, other factors such as entering training with a strong science background played a role in the similar scores. The authors conclude that PBL learning has a role in medical education and is effective with regard to basic and clinical scientific knowledgeattainment. Although they did not find significant results, it appears that the authors are content that the PBL does not hinder medical education. These studies provide evidence that non-traditional teaching techniques can be employed in training programs to teach medical information and one that is satisfying to students. These studies could be useful to those genetic counseling training programs that may be reluctant to deviate from the traditional didactic format of teaching for fear of reducing gains in knowledge.

While these aforementioned studies focused primarily on the impact PBL has on basic education, Whitfield, Mauger, Zwicker, and Lehman (2002) explored the impact of PBL on not only knowledge but also clinical skills. The authors researched the effect of problem-based (PBL) vs. lecture-based (LBL) teaching modalities on fund of knowledge (FK) and clinical problem-solving skills (CPSS). The former relates to basic medical knowledge, whereas the latter is in relation to patient related skills such as history taking, patient interactions, and physical examinations. Analysis was based upon evaluations from four clerkships conducted by third year medical students at Penn State College of

Medicine. Mean scores on FK and CPSS were higher for students enrolled in the PBL curriculum compared to students enrolled in the LBL curriculum. Significant differences were found on FK in the following subject areas: family and community medicine, obstetrics/gynecology, pediatrics, and surgery. Significant differences in CPSS were noted in the following areas: family and community medicine, medicine, pediatrics and psychology. Scores on the United States Medical Licensing Examination (USMLE) Step 1 examination were no different between the two curricula. A statistically significant positive correlation was noted for FK and USMLE scores. A lesser positive correlation was noted for CPSS and USMLE scores as would be expected given the nature of the USMLE in that the testing is designed to assess core knowledge rather than clinical skills. This study is important for the field of genetic counseling as trainees within this profession require a large fund of medical knowledge but genetic counselors also need to be able to apply their background knowledge to clinical skills.

While many studies have been conducted on the training of medical physicians, other studies have explored the use of PBL in other health care training programs. Shenouda, Swenson and Fournier (2003) reported on the efficacy of the implementation of a PBL curriculum (Guided Discovery Curriculum) within the National University of Health Sciences chiropractic program. Acquisition of knowledge was assessed via students' scores on the National Board of Chiropractic Examiners (NBCE) part I examination. Scores from students enrolled in the Guided Discovery Curriculum (GDC) were compared to scores from students enrolled in the traditional curriculum. Students in the GDC performed significantly better than students in the traditional curriculum, achieving scores 1 SD higher. The researchers conclude that the GDC issuccessful in

teaching basic science fundamentals and prepares students for clinical practice. This finding is important to the genetic counseling profession as it demonstrates that PBL has a role in training health care professionals beyond physicians.

Susarla, Medina-Martinez, Howell, and Karimbux (2003) evaluated whether changing the Harvard School of Dental Medicine's curriculum to one which included PBL had an impact on the following: percentage of students graduating on time, attrition rates, National Board Dental Examination (NBDE) Part I scores, and percentage of students enrolling in post-graduate programs. Data was retrospectively gathered from the Office of the Registrar of the dental school and was summarized to determine the results of these four outcomes. Their findings revealed increases in timely graduation rates, NBDE scores, and enrollment in post-graduate programs. Attrition rates were lower for students who participated in the PBL curriculum. The authors conclude that incorporation of PBL in the dental school curriculum has a positive effect on academic outcomes. This study provides an interesting perspective that goes beyond the previous studies that focus on basic education and provides evidence that student satisfaction is positively impacted by PBL. It is possible that this information could be translated to the genetic counseling training programs and perhaps those programs that incorporate PBL could experience greater student retention rates and increased student satisfaction.

A study by Stuart, Sectish, and Huffman (2005), investigated the usefulness of the individualized learning plan (ILP) for medical residents during their time in a pediatric continuity clinic. ILPs are learning contracts which are utilized to guide one's learning in self-directed manner which is part of practice-based learning and improvement (PBLI). Assessment was based upon a questionnaire which included both close- and open-ended

questions. Residents who participated in the ILP program indicated that it was helpful to their learning and increased their awareness of the learning process. A difficulty identified in the program was that it was time-consuming to implement the ILP. The authors conclude that utilizations of ILPs are an effective way to introduce residents to PBLI and self-directed life-long learning.

Thomas et al. (2005) studied the effects of evidenced-based medicine (EBM) conferences versus EBM small-group discussions versus no intervention on internal medicine residents' competencies in clinical decision making. Assessment of EBM knowledge and skills was performed utilizing a self-reporting examination and was administered to all three study groups. The results indicate that the small-group discussion group demonstrated a higher competency in EBM compared to either the conference group or the reference group. In addition, the small-group discussion group reported more confidence in critical appraisal, as well as increased satisfaction with the format. This research, as well as the aforementioned study by Stuart, Sectish, and Huffman (2005), provides evidence that there are multiple means of incorporating PBL into curriculum and genetic counseling programs could consider any number of PBL teaching mechanisms with the understanding that some methods may be more time-consuming than desired.

Ogrinc et al. (2007) conducted a randomized controlled trial to assess the effects of practice-based learning and improvement (PBLI) in 1st year medical students at DartmouthMedicalSchool. PBLI instruction was introduced into the curriculum relating to interviewing, physical examination skills and to the doctor-patient relationship. Outcomes of these groups were compared to students' outcomes who did not receive

PBLI. Students in the PBLI curriculum scored higher on a standardized assessment tool (Quality Improvement Knowledge Application Tool) and enhanced their self-assessed proficiency compared to the control group. Both of these aspects were measured and compared using pre- and post-tests. There were no significant differences between students in the PBLI group and the control group on their performance on the Observed Structured Clinical Examination (OSCE). Satisfaction scores varied for both students and faculty within the PBLI group but were generally low. Students and faculty stated the PBLI module took too much time. The authors conclude that 1st year medical students were able to incorporate PBLI into their learning. While this study was not based in the United States, it does provide support that PBL techniques can be implemented in the early stages of a program which may be beneficial to genetic counseling programs. However, like other studies, the subjects of this study were concerned about the time commitment required by PBL.

The majority of these studies reveal that utilizing PBL methods provide favorable outcomes, as measured by increases in knowledge, student satisfaction, graduation rates and enrollment in future programs (Curtis et al., 2001; Shenouda et al., 2003; Susarla, et al. 2003; Thomas et al., 2005; Whitfield et al., 2002). Although a few studies demonstrate unfavorable outcomes, all of them conclude that PBL has an important role to play in medical school education and should continue to be integrated into the curriculum (Enarson & Cariaga-Lo, 2001; Ogrinc et al., 2007; and Stuart et al., 2005). There is overwhelming evidence from these cited studies that PBL has a role in training medical residents which does not compromise knowledge gains. In addition, residents report a high level of satisfaction with these methodologies which is critical to any

curriculum's success. These outcomes provide credence to ACGME's move toward incorporating PBL into medical school'score curriculum.

The effectiveness of PBL has been studied extensively in medical school training; however, the same cannot be said for other health care professions. Research conducted in other medical fields would be important to determine if PBL could be used in these other areas of health care. Specifically, master-level genetic counseling training programs are often housed in medical schools and may be impacted by ACGME's requirements. Although, the amount of PBL used in these programs is unknown it would be expected that PBL could be incorporated into these training programs as well. Evaluating the amount of PBL currently being incorporated in the genetic counseling training programs would provide an initial assessment. The field of genetics is constantly expanding and is greatly impacted by informatics. In addition, certified genetic counselors are required to engage in continuing education upon graduation similar to other health care professionals. Therefore, one could speculate that this field could benefit from the skills that PBL has to offer.

Year of study and practice-based learning. In the healthcare literature, there are a few articles which address practice-based learning (PBL) within the context of year of training. Even fewer have compared satisfaction with PBL among students in the first year of study versus later years of study. This section will summarize some of the pertinent literature related to first year students and use of PBL. Two of the articles are related to pharmacology training, whereas two others are in the context of medical school.

A study conducted by van den Hurk, Wolfhagen, Dolmans, and van der Vleuten (1999) investigated how students enrolled in a medical school in the Netherlands used generated learning issues and assessed whether there were differences between students in varied years of training. Generated learning issues refer to the self-directed learning that takes place with PBL, specifically what knowledge the student determines should be acquired. The authors found that first year students used more content learning rather than self-generated learning; however, students in later years of study adapted to their own learning needs and became more self-directed learners with increasing years of training.

The findings from the above study are echoed in an article by Doig and Werner (2000) that described the development of a medical school curriculum in a Midwestern university in the United States. The authors note that although the goal for medical schools is to incorporate PBL into the curriculum, this may be difficult for first year trainees. Therefore, the administrators of this medical school recognized the importance of including traditional or lecture-based classes into the first year of the curriculum in order to provide a foundation before entering into a PBL curriculum beginning in the second year of study. Evaluation among the students noted that satisfaction with the degree of time spent on teaching basic science, as well as the quality of the teaching, was increased compared to students enrolled in previous years. Doig and Werner stated that providing the foundation allows for scaffolding and can "create meaningful medical constructs" going in to the second year of study (Doig & Werner, 2000, p. 176). This supports a constructivist view of learning in that one needs to bring a baseline understanding of concepts "in order to provide contextual meanings" (Doig & Werner,

2000, p. 177). These two studies underline the importance of teaching the basics before embarking on PBL for learners early in their training.

Similarly, in 1998 Brandt, Clements, and Piascik described the creation of a new pharmacology doctoral program in the United States. When asking faculty about issues that need to be considered for curriculum development, it was often cited that first year students focus on basic science. Therefore, faculty believed that a strong PBL curriculum would not be successful in the first year of training because these students cannot apply information as they (1) do not have the context and (2) do not know how pharmacists solve patient-related problems. Subsequently, the administrators of this doctoral program used a modified PBL program for the first year students with the following goals: (1) to develop knowledge, skills, and attitudes of a pharmacist-in-training; (2) apply problem solving techniques to patient scenarios; (3) grasp the pharmacist care model; (4) increase professional attitudes and behaviors; 5) use didactic taught information and apply to patient scenarios in small group exercises; 6) work in groups to achieve goal of problem solving; and 7) identify and use relevant resources to problem solve. These last three goals underscore PBL concepts of small group learning and the need to be able to identify resources on one's own. After implementation of this modified PBL curriculum for first year students, informal interviews with practitioners who were involved with these students indicated that there was an increase in preparedness, in knowledge, in greater understanding of pharmacist's role, and students were better able to counsel patients. Students also rated the quality and realism presented in the curriculum as favorable; however, there were some negative comments from students. These relate to ambiguity with the small group exercises and some students perceived redundancy within

the curriculum. This study demonstrates that there is a role for PBL in the first year of study although perhaps a modified curriculum is beneficial in order to provide the groundwork needed to build upon for in-depth PBL. Additionally, first year students appreciate the relevance PBL provides even in the early stages of training.

In order to determine if students with a specific learning style preferred PBL techniques, Pungente, Wasan and Moffett (2003) assessed the learning styles of first year pharmacology students with their preference of specific forms of PBL practices. The Kolb Learning Style Inventory was used to assess learning style and a five – item questionnaire was used to assess PBL preferences. The latter survey was administered at two points in time approximately 4 months apart. Among the group of 116 students, all of Kolb's four learning styles (i.e. assimilator, converger, diverger, and accommodator) were identified. All groups favored PBL practices although on the first administration of the PBL survey convergers had the highest scores. Subsequently, on the second administration assimilators had the highest satisfaction scores. In addition, as students experienced more PBL throughout their training in the first year, all but the divergers reported increased satisfaction with PBL techniques. Therefore, the authors conclude that divergers may not be well-suited for PBL curricula whereas convergers may be best suited as these individuals rated PBL techniques the highest.

Practice-based learning is an effective teaching method, especially for adult learners who are self-directed and have the ability to apply information. However, administrators of programs may wish to consider the amount of PBL used especially early in training as there is a need to provide the necessary context for which to apply information as requisite for PBL. Additionally, not all learners may be able to incorporate

PBL and may be best employed with students who have a learning style that best fits experiential learning. As demonstrated by Pungente, Wasan and Moffett (2003) since there are several types of learning styles, not all learners may benefit from PBL and could prefer other teaching methods. It may be prudent for those programs that use PBL to assess learning styles to determine how to modify curricula to best suit their trainees.

Learning Styles and Related Inventories

Learning styles describe the factors, often extrinsic, that increase one's knowledge gains and leads to enhanced integration of information. Thus, learning styles define *how* an individual learns most effectively. In addition, learning styles consider the uniqueness of each person in the context of learning and emphasizes individual differences while at the same time allowing for integration of certain teaching practices in the classroom by incorporating different teaching strategies or by providing different experiences for the learner.There are several learning style theorists and accompanying inventories to assess one's preferred learning method. The following is a summary of the some of the most common models and associated inventories that have been used in the literature.

Kolb's experiential learning theory. According to Kolb, for learning to be effective there are four modes which occur in a cyclical manner. "Experiential learning is a process of constructing knowledge that involves a creative tension among the four learning modes" (Kolb & Kolb, 2009). The steps or modes a learner needs to go through are experiencing, reflecting, thinking and acting. The first is concrete experience (CE) in which one explores fully without biases to new experiences. Individuals in this stage are open to try new things. The second phase is reflective observation (RO) in which individuals can reflect on and observe experiences. While in this stage, people can

appreciate varied perspectives. In the third stage, abstract conceptualization (AC), individuals can create concepts and integrate observations into theories. The fourth and final stage is active experimentation (AE) in which one uses theories to make decisions and problem solve (Kolb, 1984). These four stages are paired into two poles of comprehending or grasping experience by creating tension between CE and AC and the other is transforming experience caused by tension between RO and AE (Sadler-Smith, 2001).

In order to assess our inherent styles and ways of learning, the Learning Style Inventory (LSI) was developed by Kolb in 1971. The first version of the LSI was a 9-item self-reported questionnaire which required ranking 4 words which best fits one's learning style. Each word relates to CE, RO, AC, and AE. The LSI has been modified over the years to address issues of reliability and validity. The second version, created in 2005, is the LSI 3.1 which consists of 12 items. In the spring of 2011, the LSI 4.0 was published which is an on-line version of the survey. This latest version maintains the 12 questions from the 3.1, with slight modifications, and adds eight additional questions to assess learning flexibility. Therefore, the 4.0 is two assessments in one inventory relating to learning styles and learning flexibility. Of the questions that assess learning style, there are questions which rate AC-CE (abstract over concrete) and AE-RO (action over reflection). The LSI has been used extensively to assess learning across several disciplines. From its widespread use, learning styles have emerged based on which abilities dominate learning. Some styles are based on one mode of learning whereas others incorporate one dimension from grasping experience and another from transforming experience. The former consist of experiencing, reflecting, thinking, and

acting. The latter include diverging, assimilating, converging, and accommodating learning styles. Over time these terms have been renamed to initiating, imagining, analyzing, and deciding, respectively. A ninth style has emerged in which a person learns by balancing all four modes, thus this style has been named as balancing; however, most studies do not assess this last learning style (Kolb & Kolb, 2009).

Identifying individuals' learning style is helpful for adult educators so that we can provide an optimum learning experience for the learner. By having an understanding of whether someone learns better by hands-on experience, working in groups, or by sitting through lectures can lead to more effective learning. It is important to recognize that learning styles vary according to what we are learning to master; however, more importantly, our learning style is shaped by our previous experiences.

Gregorc's Mind Styles Model. Gregorc believes we learn by "perception" or how we take in information and "ordering" which is how we reorganize, draw upon and prioritize information which he formulated into his Mind Styles Model (Gregorc Associates, 2010). Some researchers speak of only these two dimensions of which perception can be concrete or abstract whereas ordering can be random or sequential (Coffield, Moseley, Hall & Eccelstone, 2004). However, Gregorc described four dimensions that each has two poles in which a learner processes information. Gregorc claims that individuals have natural predispositions for learning along four bipolar, continuous "mind qualities" that function as mediators as individuals learn from and act upon their environments. Those mind qualities are abstract and concrete perception, sequential and random ordering, deductive and inductive processing, and separative and associative relationships (Mind-Styles, n.d.).

The Gregorc Style Delineator (GSD) is an inventory which identifies four learning styles of Concrete-Sequential (CS), Abstract-Sequential, (AS), Abstract-Random (AR), and Concrete-Random (CR). A score between ten and 40 is awarded to each style with a maximum of 100. Similar to Kolb's LSI, the GSD asks respondents to rank ten sets of four words. The CS learner prefers direct, hands-on experience, likes order and a logical sequence to tasks, and is a perfectionist. The AS learner is analytical, ideas and symbols assist in learning, is logical and sequential in thinking, and is focused. The AR learner is emotional and sensitive, is people-oriented, prefers discussions and conversations that are wide ranging, and wants time to reflect on experiences. The CR learner is experimental and a risk taker, likes to explore unstructured problems, is intuitive, is independent, and uses trial and error to work out solutions (Hawk & Shah, 2007; Mind-Styles, n.d.).Gregorc believes that each learner and teacher has a preferred style and it is important to reconcile teaching methods to the learner's style. If dramatic differences occur, then the student may be harmed. (Coffield, Moseley, Hall & Eccelstone, 2004).

Felder – Silverman model. The Felder –Silverman model has been used extensively; however, its roots were to assess the teaching effectiveness within the field of engineering. This model places learners along five bipolar continua which are: Active-Reflective, Sensing-Intuitive, Verbal-Visual, Sequential-Global, and Inductive-Deductive. Felder and Silverman borrow from Kolb and Jung regarding the active-reflective style and the sensing-intuitive, respectively (Felder & Silverman, 1988). Those who are active learners like to work with others and process by experimenting whereas reflective learners prefer to work alone and process information by mulling things over.

Sensing learners are more factual and realistic compared to intuitive learners who are more theoretical and conceptual. Individuals who are visual learners favor pictorial representations, which is contrary to verbal learners who learn by written and auditory cues. Sequential learners, as the name implies, prefer to learn in a linear manner whereas global learners look at things from a more general standpoint. Individuals who are inductive learners favor teaching techniques that start with specific topics and move to general concepts, which is the opposite of deductive learners who prefer a learning format that begins in general terms and becomes more specific (Graf, Viola, Leo, & Kinshuk, 2007).

Felder and Barbara Solomon created the Index of Learning Styles (ILS) that evaluates all but the intuitive-deductive style. Learners are expected to have skills along each of the other four continuums and can strive to change their preferences. This inventory is comprised of 44 questions and asks respondents to choose one of two endings to complete sentences that address issues of learning. This instrument has not been validated which makes it questionable to use in research (Hawk & Shah, 2007).

Felder and Silverman suggest that teaching methods should incorporate varied strategies in order to enhance learning for individuals of all styles. They suggest that activities should be diverse such as including group and individual work, offering lectures with time for the students to think and reflect, and use visual aids such as films along with hands-on activities (Felder & Silverman, 1988).

Fleming and Mills' VARK model.VARK is an acronym for Visual, Aural, Read/write and Kinesthetic and was derived from a model that was created by Neil Fleming and Colleen Mills. This model differs from others in that they do not set forth a learning style theory as Fleming and Mills believe it is difficult to teach toward the diverse styles students possess. Rather, they believe it is more beneficial to empower students to realize their own learning style and to determine for themselves how they learn best. Fleming and Mills wanted to create an easy way for students to determine their learning style (Fleming & Mills, 1992). According to Fleming, learning occurs by an individual's preference of "gathering, organizing and thinking about information" (Hawk & Shah, 2007, p. 6). This model recognizes that we use our senses to learn and account for four of the five senses, with only taste being excluded. According to this model, learners may have a preference for only one sensory mode or can learn via a combination of these modes. The most recent inventory is comprised of 16 questions which ask the respondent to answer how they would respond to 16 scenarios. For each learning style, there are specific techniques which would enhance their learning (Hawk & Shah, 2007). After completing the questionnaire, students are given tips to assist them in addressing how to improve the effectiveness of the teaching to which they are exposed.

Dunn and Dunn learning style. The Dunn and Dunn learning style addresses how students take in, process, integrate and retain information. They describe learning in the context of stimuli of which there are five: environmental, emotional, sociological, physiological, and psychological processing. Within each of the five stimuli, Dunn and Dunn have described four elements thereby making 20 total elements which comprise learning. Environmental addresses the features within the setting that learning is taking

place, such as lighting, sounds, temperature and seating. Emotional aspects are innate factors such as one's motivation, persistence, structural needs, and sense of responsibility. The sociological stimuli relates to whether one prefers to learn in a group setting or by oneself, with colleagues/peers, with a student-teacher dynamic, or in a varied manner. Physiological factors are those which are addressed in the VARK model, visual, auditory, kinesthetic, as well as one's energy level and physical needs. Lastly, the psychological factors take into account whether one is impulsive or reflective and how one processes information (Coffield, Moseley, Hall & Eccelstone, 2004; International Learning Styles Network, 2008).

The inventory that assesses the Dunn and Dunn learning style is the Productivity Environmental Preference Survey, or PEPS, which is the adult version of their inventory and excludes questions related to assessing teacher or parental motivation. There are 100 questions on the PEPS which ranks the 20 elements on a continuum. A five-point Likert scale is used to answer the questions.

Honey and Mumford. This model was created in response to Kolb's LSI; however, Honey and Mumford wanted to shift away from direct questioning of how one learns and preferred to address behaviors that result in how we learn. Honey and Mumford describe four types of learners: activists, reflectors, theorists and pragmatists. They place these learners on a cycle which resembles Kolb's learning cycle with activists in stage one and ending with pragmatist in stage four. Activists are open-minded and are willing to explore new ideas; reflectors are methodical and thoughtful; theorists are rational, are able to ask exploratory questions and can see the past the immediate issue;

lastly, pragmatists are realistic, have a straightforward approach and are anxious to try out new theories (Coffield, Moseley, Hall & Eccelstone, 2004).

Honey and Mumford created the Learning Style Questionnaire (LSQ) to assess their learning styles. The third, and most current, version of the LSQ consists of 80 questions, twenty each that assess for the four different learning styles. However, several studies have called into the question validity of this instrument.

While there are several learning style models reported in the literature, only a few have developed inventories to assess that particular style. Of the inventories, some have been well validated, whereas others have not. In addition, some of the theories overlap with each other often due to the fact that one influenced another, so one can see resemblance of one theory in another. However, it is clear that there are several concepts presented within these various models which speak to the complexity of learning. Learning is multi-faceted and no one model will be able to explain how everyone learns. Hawk and Shah (2007, p. 12-13) present a helpful summary of some of the inventories, excluding Honey-Mumford, and help delineate which combination of inventories would be useful when performing research.

Since each learning style inventory is assessing different elements, Hawk and Shah created a list of ten elements which would be addressed by the inventories of Kolb, Dunn and Dunn, Felder-Silverman, VARK and Gregorc. Hawk and Shah (2007) developed the following which lists the facet of learning and the corresponding theory which would address that element: (1) the concrete and abstract dimension (Kolb and Gregorc); (2) the active and reflective dimensions (Kolb, Felder–Silverman, and Dunn and Dunn); (3) the sequential and random/global dimensions (Gregorc, Felder–

Silverman, and Dunn and Dunn); (4) the visual, aural, read/write, and kinesthetic dimensions (Felder–Silverman and VARK); (5) the intuitive and sensing dimensions (Felder–Silverman); (6) the sociological elements of learning through self, pairs, peers, with a teacher, and mixed (Dunn and Dunn); (7) the environmental elements of sound, light, temperature, and room design (Dunn and Dunn); (8) the emotional elements of motivation, persistence, responsibility, and structure (Dunn and Dunn); (9) the physical elements of perceptual, intake, chronology, and mobility (Dunn and Dunn); (10) the psychological element of hemisphericity (Dunn and Dunn).

Thus, researchers must take into account which aspects of learning they are most interested in pursuing and choose the most appropriate tool(s) to obtain that information. Hawk and Shah present practical information too, such as the costs associated with the individual surveys and the length of the questionnaires. Some of these inventories are free of charge, whereas others have significant fees associated with their use. Depending on the setting of the research, time constraints and whether there is online access are factors which need to be considered. Lastly, they bring up the important issue of reliability and validity of the individual surveys. Those which have the most robust validity and reliability are the LSI, PEPS, with VARK having a bit less support. According to Hawk and Shah, the Gregorc model has strong reliability but low validity, and as stated above, the ILS does not demonstrate strong reliability or validity.While each tool has its own issues, Hawk and Shah assert that by assessing learning style and subsequently employing correlated teaching techniques there will be five outcomes for the adult learner, one of which is increased satisfaction.

Although there are few studies that investigate the relationship between learning style and student satisfaction, performing such a study within the field of genetic counseling could ascertain important information for educators within this field. If learning style relates to increased satisfaction, then perhaps program directors would consider analyzing learning styles of their students in order to improve satisfaction. As there are many ways in which satisfaction can be quantified, there are several tools that attempt to evaluate students' perceptions regarding the learning environment that can be applied to the field of genetic counseling.

Student Satisfaction

Although there is an abundance of recent studies that have explored student satisfaction related to instructional methods in the classroom for health care professions, these studies have mainly focused on traditional teaching methods versus computer-mediated teaching, or distance learning. While this information is important with the expansion of distance learning educational programs, only one genetic counseling training program has attempted a distance learning program and has been fraught with difficulties. Therefore, information from these studies will be more beneficial if, and when, these types of programs increase in frequency and are successful. Other studies have concentrated on clinical setting instruction or fieldwork. Few studies have explored which factors influence satisfaction in the classroom. However, for those studies which have attempted to evaluate student satisfaction, the basis of the assessment has been drawn from job satisfaction studies (Stith, Butterfield, Strube, Deusinger & Gillespie, 1988; Ziaee, Ahmadinejad, &Morravedji, 2004). While some correlations can be drawn from the human resource field, a student's position is not the same as an

employee,thereby limiting the effectiveness of using similar assessments for satisfaction related to employment and schooling. However, studies have shown that increased student satisfaction is important in the long-term as there is increased professional attitude, commitment to the field, and retention in one's career (Stith, Butterfield, Strube, Deusinger & Gillespie, 1988; Ziaee, Ahmadinejad, &Morravedji, 2004). Therefore, gaining an understanding of the factors that influence student satisfaction is a benefit to the educators of future professionals in all career fields.

Although is it difficult to draw similarities from the human resource arena, Stith et al (1988) believe that there are some elements of job satisfaction surveys that could be used when assessing student satisfaction. In particular, during a study of physical therapy students, the authors believed that three domains from job satisfaction evaluations were pertinent to use. These included the personal domain which assessed student characteristics, the interpersonal domain which was the relationship between student and instructor, and the organizational domain which related to the clinical setting in which education took place. This study evaluated physical therapy students who were enrolled in either their first or second year of training. Satisfaction in any of the three domains did not correlate to the year of study, thus there were no significant differences in satisfaction for first or second year students. With regard to the personal domain, the students' personal life satisfaction was positively correlated to their overall satisfaction with their training, as would be expected. If one is unhappy with their general life circumstances this would likely negatively impact other activities in which one participates. In the interpersonal domain, the instructors' teaching skills were the best predictor of overall satisfaction. Teaching skills were not further defined, thus it is difficult to speculate on

what this specifically relates to. Due to methodology problems, the organizational domain was difficult to assess in this study; however, increased variety of patients, of learning opportunities, and of clinical skills increased satisfaction. While their study was fraught with logistical problems which led to difficulties in drawing broad conclusions, the authors were able to gain some beneficial information which could translate to an assessment of genetic counseling programs.

Another study which utilized previous work from job satisfaction surveys was conducted by Ziaee, Ahmadinejad, and Morravedji (2004) that evaluated medical students' satisfaction with clinical instruction. As they reported, previous studies have demonstrated that satisfaction is positively affected by the number of faculty, the number of patients seen, educational methods, and acquisition of skills. The authors of this study adapted a job satisfaction survey to meet their need to assess medical school education. Ziaee, Ahmadinejad, and Morravedji(2004) surveyed students from The University of Tehran Medical School and assessed the program on a variety of elements; however, only those related to organizational structure or classroom factors will be discussed herein. Their results indicated that satisfaction was increased when students were taught by experienced faculty in the classroom. In addition, perception of well thought out course planning and curriculum was viewed as increasing satisfaction. Lastly, class size was statistically significant in determining satisfaction; however, the authors do not elaborate on whether a smaller class is preferred over a larger class size.

While the above studies evaluated coursework and organizational factors, other studies have focused on the best way to educate students in health care programs. One such study by Emmons, Sells, and Eiff (2002) assessed student satisfaction regarding the

teaching of women's health issues, as well as the best manner to gain knowledge in this content area. Students in four disciplines were surveyed, including family practice, obstetrics, pediatrics, and in internal medicine. When comparing educating via a clinical setting versus a didactic setting, students in all disciplines preferred the clinical setting. This speaks to the benefit of experiential learning and like the findings from Henzi et al (2005), students report a higher level of satisfaction when the information is made relevant. Although not stated by the authors of this particular study, one would assume that it was the hands-on experience that led to an increased satisfaction. In addition, the students in this study preferred small group learning experiences over large group activities. It is possible that small group interactions allowed for a more meaningful learning experience, although the authors did not elaborate more on this finding nor did they explore program characteristics.

As mentioned earlier in this review, many studies have concentrated on satisfaction within students' field placement. While this is not a focus of this dissertation, there are some findings which can be extrapolated to the didactic setting. For example, a study of social worker field placements found that students' satisfaction was increased when they had exposure to more than one faculty member (Showers, 1990). Interestingly, satisfaction rates were not affected by involvement with less experienced faculty; however, this was assessed during fieldwork placements and not in the realm of didactic teaching. Therefore, it is unknown whether these students would prefer more experienced faculty in the classroom versus in the clinical setting. This is an important area for the field of genetic counseling as 69% of the respondents of the 2012 NSGC Professional Status Survey report involvement in teaching/education of genetic

counseling trainees. Given that 44% of genetic counselors surveyed have less than five years of experience, many of the faculty and clinical supervisors of graduate students in genetic counseling training programs will not have a wide breadth of experience (National Society of Genetic Counselors, 2012).

Many genetic counseling programs are small in size, less than ten students, and for this reason often incorporate classes from other departments and health care disciplines at their respective institutions. A study by Curran, Sharpe, Forristall, and Flynn (2008) assessed factors that would be beneficial to genetic counseling training programs. The authors evaluated satisfaction regarding computer-based versus face-to-face interprofessional case based learning. In this study, 520 undergraduate students in medicine, nursing, pharmacy, and social work programs participated in the evaluation from a programmatic standpoint, as well as assessing their satisfaction of the interprofessional course and their perceptions of the collaborative learning experience. The results of the study indicated that face-to-face instruction with interprofessional case based learning was preferred over computer-mediated programs. In addition, the majority of the students, with the exception of the medical students, preferred the small group educational sessions over the larger group. Of note, the size of the small groups were not specified, thus is it difficult to determine how this information translates to genetic counseling programs. However, the results from this study could be relevant to genetic counseling training programs in that it demonstrates satisfaction with interprofessional learning opportunities and the preference of small group activities. As genetic counseling training programs expand the number of students they enroll, it would be important for program directors to consider ways to maintain small group learning activities. In

addition, as program class size increases, it may become more difficult for classes in other disciplines to absorb a larger group of genetic counseling trainees and there may be a tendency to become more insular within the genetic counseling program. This could lead to less interprofessional classes which may lead to dissatisfaction for genetic counseling graduate trainees.

Assessment of learning environment. While there are many aspects that may affect student satisfaction, one specific area that can be investigated is students' perception of the learning environment. The learning environment is the perception of the internal and external factors that either augment or hinder one's learning. These factors can include the physical environs, perceived support from faculty, the relevance of presented information, as well as the personal relationships among classmates. Several scales have been developed to assess students' perceptions of the learning environment. Some are to be used with the undergraduate population, whereas others are specific to graduate students. Additionally, many of the scales were created to assess students within certain fields of study. The following describes those that relate to the healthcare field specifically.

Medical school learning environment scale. In the early 1970s, Robert Marshall noted that students enrolled in the Chicago Medical School reported dissatisfaction and difficulties with adjusting to the training program. In order to intervene, Marshall decided to measure students' perceptions of the learning environment and thereby developed the Medical Student Learning Environment Survey (MSLES) (Marshall, 1978). Marshall modeled the MSLES on Rothman's Learning Environment Questionnaire (LEQ); however, the concepts of the LEQ were expanded in the MSLES.

The MSLES, a 55-item survey, is comprised of seven scales, four of which are based on the LEQ and three additional areas. The first novel scale is that of Meaningful Learning Experience that assesses the relationship between the demands from coursework and the relevance of knowledge. The issue is not only the quantity of material required to learn but it is easier if the material is related to the future work or role as a physician. Students have a higher meaningful learning experience score if there is clearer relevance between the science and clinical concepts and when there is greater problem solving and experiential learning. Both of these aspects are enhanced with practice-based learning. The second scale created specifically for the MSLES is Emotional Climate which is a psychological assessment and evaluates emotional reactions. This scale was created so that the inventory was not only an assessment of intellectual aspects of training. The third scale is Nurturance that evaluates the school's support which is important as this can translate to the professional's role with patients or clients. The fourth scale is Breadth of Interest which is the degree the program "fosters interest and activity" not only in medicine but outside the field too (Marshall, 1978, p. 99). Student Interaction, the fifth scale, assesses peer-to-peer relationships, and the sixth scale is Organization which relates to how coherent the program is and how well the curriculum is planned out. The seventh and final scale is Flexibility which evaluates how adaptive the administration is from a systems level. These last four scales were adapted by Marshall from the LEQ.

As Marshall stated, the inventory is suited for studies exploring the relationship between satisfaction of learning environment and academic performance. In addition, the information garnered from the responses allows for identification of areas to improve the learning environment (Marshall, 1978). According to Clarke, Feletti, and Engel (1984)

measuring the perception of learning environment is important as it is a significant determinant of learning which can impact attitudes. Furthermore, assessing the learning environment is a general measure of student satisfaction and is a way to monitor necessary curricular changes (Clarke et al., 1984).

Other researchers have used the MSLES to assess various aspects of medical education. Lieberman, Stroup-Benham, Peel and Camp (2001) studied medical students enrolled in a traditional curriculum versus a practice-based learning (PBL) curriculum and compared their scores on the MSLES. The scores for the Meaningful Learning Experience scale were higher for those students enrolled in the PBL curriculum compared to those in the traditional curriculum prior to clinical rotations. However, after those in the traditional curriculum experienced their clinical rotations, the scores were equalized. Thus, PBL had a temporary effect on the satisfaction of the students. Lancaster et al. (1997) surveyed 341 medical students, in two medical schools, over a three year period to assess the perception of the learning environment by utilizing the MSLES. The first year students enrolled in a PBL curriculum had higher levels on the Meaningful Learning Experience, Flexibility, Supportive, Breadth of Interest, Student Interaction, and Nurturance scales compared to students in lecture-based curriculum. The lowest rated scale was that of Organization which Lancaster et al. speculates is due to the inherent nature of PBL as this teaching modality is often less rigid compared to didactic teaching. The authors conclude that the results "support the hypothesis that this increased satisfaction is an effect of the PBL curriculum" (Lancaster et al., 1997, p. S11-S12). Additionally, the authors speculate that the positive ratings of the learning environment could possibly indicate that the students perceive lifelong learning as positive and could

impact the desire to learn in future years. These studies indicate the positive impact PBL has on students' perceptions of the learning environment which has not been assessed in the genetic counseling field; however, this information could provide useful to those involved in the genetic counseling training programs.

Dental student learning environment survey. Henzi et al. (2005) used a modified version of the MSLESto assess dental students' perceptions. Since there was no comparable evaluation tool for dental students, Henzi et al. (2005) adapted the MSLES and created the Dental Student Learning Environment Survey (DSLES). This study of students, in their freshman and junior years, enrolled in dental schools across the United States was conducted in 2002 because the authors recognized that no broad-based reports and multi-school assessment had been conducted regarding dental students' perceptions of educational experience and learning environment. The authors stated that it is important to know this information as an understanding of students' overall experience can help improve student performance and subsequently increase satisfaction. Henzi et al. (2004) found that the highest scores were noted within breadth of interest and meaningful learning experiences. The former factor relates to the instructor's ability to recognize life outside of dental school, and the latter factor is the instructor's ability to make the didactic information relevant and ability to bridge the gap between basic science and the clinical setting. Lowest scores were noted for freshman dental students in emotional climate which is the way their class experiences affect their perception of the training program, whereas the lowest score for the juniors was in faculty support. The high rating of meaningful learning experience stresses the importance of using experiential learning and making sure the information is relevant to one's training. The low rating for the

freshmen on the emotional climate scale may result in negative feelings about future coursework and could affect their performance in their subsequent years of training. Educators of genetic counseling students can benefit from the findings of this study and evaluate how well they address those areas which are most important graduate students in other health care fields.

Jain et al. (2010) sought to investigate the learning environment, instructor-student interactions and educational environment within two dental schools within India. The authors believe it is important to evaluate curriculum as well as looking outside the program environment to determine student satisfaction. In order to perform their analysis, Jain et al. used the DSLES to assess curricular strengths and weaknesses so that improvements to the training programs could be suggested. The most highly rated scale among the 341 students surveyed was the student-student interaction and the least favorably rated scale was flexibility. Although students in their pre-clinical and clinical students varied on their subscales overall, both groups rated student-student interaction highest followed by supportiveness. However, both groups rated meaningful experience as fifth and flexibility was the lowest scored scale for both groups. The authors conclude that the subjects rated the learning experience as negative and the students perceive a lack of ability to make changes based on the low scores for flexibility. This study indicates that using the DSLES can identify areas for improvement which can be replicated in other fields.

Dundee ready education environment measure. Subsequent to the development of the MSLES, Roff et al. (1997) developed the Dundee Ready Education Environment Measure (DREEM) in order to provide an updated tool that assesses the educational

climate. Throughout 1994 and 1995, the inventory was created and modified based on input from faculty of healthcare training programs throughout the world. The final product is a 50 item scale that uses a four point Likert scale to assess five areas within the learning environment. The five subscales are the following: students' perceptions of teaching, students' perception of teachers, students' academic self-perceptions, students' perception of atmosphere, and students' social self-perceptions. By utilizing the DREEM, one can generate a profile of institutional strengths and weaknesses based on students' perceptions (Roff, 2005). Roff purported that older measurements such as the MSLES and LEQ are outdated and do not assess the student-centered learning that is currently seen in medical school training (Roff, 2005). However, Stewart (2006) contended that Roff's assertion regarding the MSLES and LEQ are not well-founded. He stated that the MSLES is consistently used in medical schools and has been used by other researchers to compare the perceptions of PBL-based programs versus traditional training programs. Therefore, Stewart believes that the MSLES is able to assess current medical training programs and is not outdated.

Soemantri, Herrera, and Riquelme (2010) provided an overall assessment of the various learning environment measurements. The authors evaluated various tools based on reported studies regarding validity and reliability, as well as which inventory is best for specific professional fields and level of education. The authors favored the LEQ, MSLES, and DREEM due to the robust psychometrics of each of these inventories. They believed the DREEM is the best survey for the undergraduate climate and for graduate-level medical training, the Post-Graduate Hospital Education Environment Measure (PHEEM) was best. However, the PHEEM assesses clinical rotations and not necessarily

education within the classroom. For assessing the dental school environment, the DSLES is most suitable as it has good reliability and better content validity compared to other inventories as it is based on the MSLES which has been proven to have good validity and reliability.

Adult learning and development student satisfaction scale. Recently, Messemer and Hansman (2012) created the Adult Learning and Development Student Satisfaction (ALDSS) Scale to assess satisfaction of adult learners from six facets: curriculum, learning format, course materials, program access,faculty and instruction, andfaculty advising. Several of these aspects are similar to the subscales seen in the aforementioned learning environment scales. For example, the faculty and instruction aspect measures how well course expectations are made clear which is akin to the organization subscale of the DSLES. Like other learning environment surveys, the ALDSS Scale assesses curricular aspects as many questions pertain to applicability to one's professional practice. One element that is not evaluated in the previously mentioned satisfaction scales but is assessed by the ALDSS Scale is faculty advising. While the ALDSS Scale is an attractive scale to use in assessing student satisfaction and has been shown to have good reliability, this 36-item scale was not publicly available at the time of this current study. The ALDSS Scale has the potential to be another useful instrument in assessing student satisfaction, especially in the context of adult learners.

In summary, previous studies regarding student satisfaction have demonstrated that various factors play a role. Although some may not be controlled by educational programs and educators, such as personal factors, others can be influenced by faculty. Assessments of the learning environment can also help determine areas of student

satisfaction. These include, but are not limited to, variety of educational opportunities, exposure to a variety of clinical settings, and involvement with more than one faculty member. Other institutional factors that increase satisfaction are employing educational activities which are small group based and incorporate experiential teaching techniques. Ensuring that the knowledge gained is relevant to one's prospective career and bridging the basic science with the clinical arena. All of these factors should be explored by genetic counseling program directors as increased levels of satisfaction have been shown to increase professional attitude, retention in the field, and commitment to the field.

CHAPTER III

METHODOLOGY

This study investigated which factors influence genetic counseling trainees' satisfaction with the learning environment of their graduate training programs. The variables that were evaluated to determine if there is an impact on satisfaction included year of study, perceived use of practice-based learning (PBL), and learning styles. Satisfaction with the learning environment was assessed by utilizing a modified version of the Dental School Learning Environment Scale that was adapted to genetic counseling. Perceived use of PBL was evaluated by 15 questions and learning style was assessed by using the Kolb Learning Style Inventory version 3.1. This quantitative study employed structural equation modeling as a way to determine the impact of hypothesized relationships between two variables directly, as well as identifying if there are mediating or intervening variables, those that are between two variables (Maruyama, 1998).

This chapter will review the purpose of the study, research question, and hypotheses. The conceptual model for this model will be presented as well as a description of the independent and dependent variables. This is followed by an explanation of the population and sample, including recruitment of subjects and ethical considerations. The instrumentation used in this study will be described, including the

scoring and psychometric properties of the various scales used within this study, as well as a description of the data collection process to be utilized. This chapter will conclude by outlining the data analysis and an explanation of structural equation modeling analysis.

Purpose of Study

The purpose of this study was to examine whether the learning styles of trainees in genetic counselor training programs, trainees' year of study, and trainees' perceived use of practice-based learninginfluence satisfaction with the learning environment.

Research question.

1. Do trainees' learning style, year of study, and perceived use of practice-based learning have effects on satisfaction with the learning environment?
    a. *Hypothesis 1:* The learning styles of genetic counseling trainees have a direct impact on the satisfaction with the learning environment.
    b. *Hypothesis 2:* Perceived use of practice-based learning has a direct impact on satisfaction with the learning environment.
    c. *Hypothesis 3:* Genetic counseling trainees' year of study has a direct impact on learning styles.
    d. *Hypothesis 4:* Genetic counseling trainees' year of study has a direct impact on perceived use of practice-based learning.
    e. *Hypothesis 5:*Genetic counseling trainees' year of study has both a direct impact on the perceived use of practice-based learning and an indirect impact through learning style and perceived use of

practice-based learning on satisfaction with the learning environment.

Conceptual Framework

The conceptual framework of this study was to determine which variables influence the satisfaction with the learning environment of those students within the genetic counseling training programs throughout North America. Four independent variables were evaluated to determine if there is a relationship between these variables and the satisfaction with the learning environment, the dependent variable. Figure 1 shows the three independent variables; year of study, learning styles, perceived use of practice-based learning techniques and their relationship on the dependent variable of satisfaction with the learning environment.

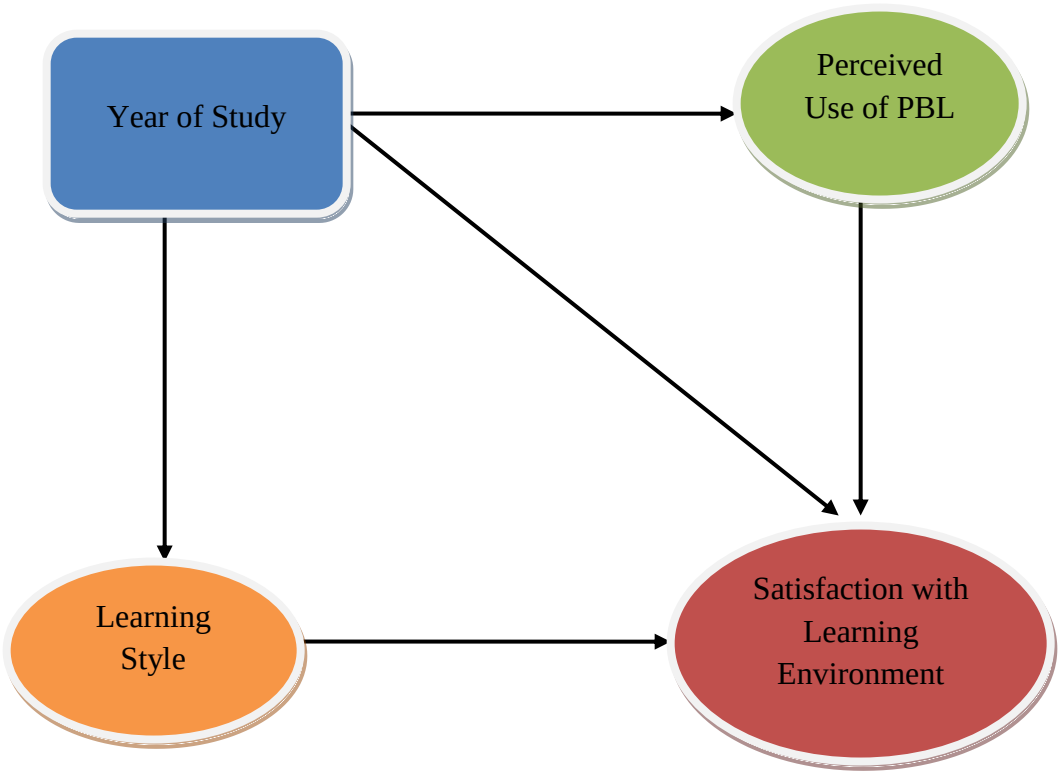


Figure 1. Conceptual Model

Year of study is a bimodal variable as the majority of the genetic counseling training programs are approximately two years in length or a minimum of 21 months. Therefore, this study surveyed first-year students who were enrolled in their programs for one semester whereas second year students had been in their training programs for over one year. Those trainees who were enrolled in programs that train students beyond the typical 21 month duration were collapsed into the second-year grouping as they are more advanced in their training. Year of study was an independent variable that was assessed to determine if this variable impacted trainee learning style as well as perceived use of PBL and satisfaction with the learning environment.

Learning styles are defined as the preferred manner in which adult learners integrate educational information. Although there are various scales that determine learning styles, for this study Kolb's learning styles was utilized. With regard to student learning styles, as previously reported in the literature, it was anticipated that learning styles would be different between students who are in their first year of training compared to those in their second year of study; therefore, this was evaluated in this study. Although not widely studied previously, it was hypothesized that students' satisfaction with the learning environment would be impacted by learning style. It was speculated that students with certain learning styles would have higher levels of satisfaction compared to those with other learning styles.

Perceived use of PBL is the students' opinion of how extensive PBL teaching techniques are employed in their respective programs. PBL teaching techniques are those that are self-directed and experiential-based in which the outcome is continual improvement. It was anticipated that first-year students would perceive a lesser amount

of PBL compared to second-year students given the learning curve required in a specialty training program. Since PBL relies on experience and ability to apply information, it stands to reason that more PBL will be used in advanced training; therefore, the impact of year of study on this variable was evaluated. Perceived use of PBL was expected to influence satisfaction with the learning environment given PBL is often favorably rated by students who are exposed to this teaching modality.

Satisfaction with the learning environment is a measure of various factors of the training program that reflect differing aspects related to student learning. These include, but are not limited to, emotional support, peer-to-peer interactions, meaningful experiences, and organizational aspects. Student satisfaction of the learning environment was predicted using three variables. The first is whether there was a difference between first- and second-year students, the second was their learning styles, and the third was the students' perception of the utilization of PBL. It was unknown whether year of study would have an effect on satisfaction levels; however, given this study evaluated students with approximately three to four months of training versus approximately 15 months it was expected that satisfaction scores will differ between these two groups. As stated above, it was hypothesized that subjects with certain learning styles would have varied satisfaction with the learning environment. Previous studies have found that learning environment scores increase when PBL methods are employed in the classroom; therefore, this hypothesis was explored in this current study.

Figure 2 shows the conceptual model with the latent variables and the corresponding observed variables. As will be described later in this chapter, each observed variable is determined by aspects of the questionnaire used in this study. In this

figure, the latent variables are represented by ovals whereas the observed or measured variables are represented by rectangles. The arrows indicate the direction of the predicted relationship between variables.

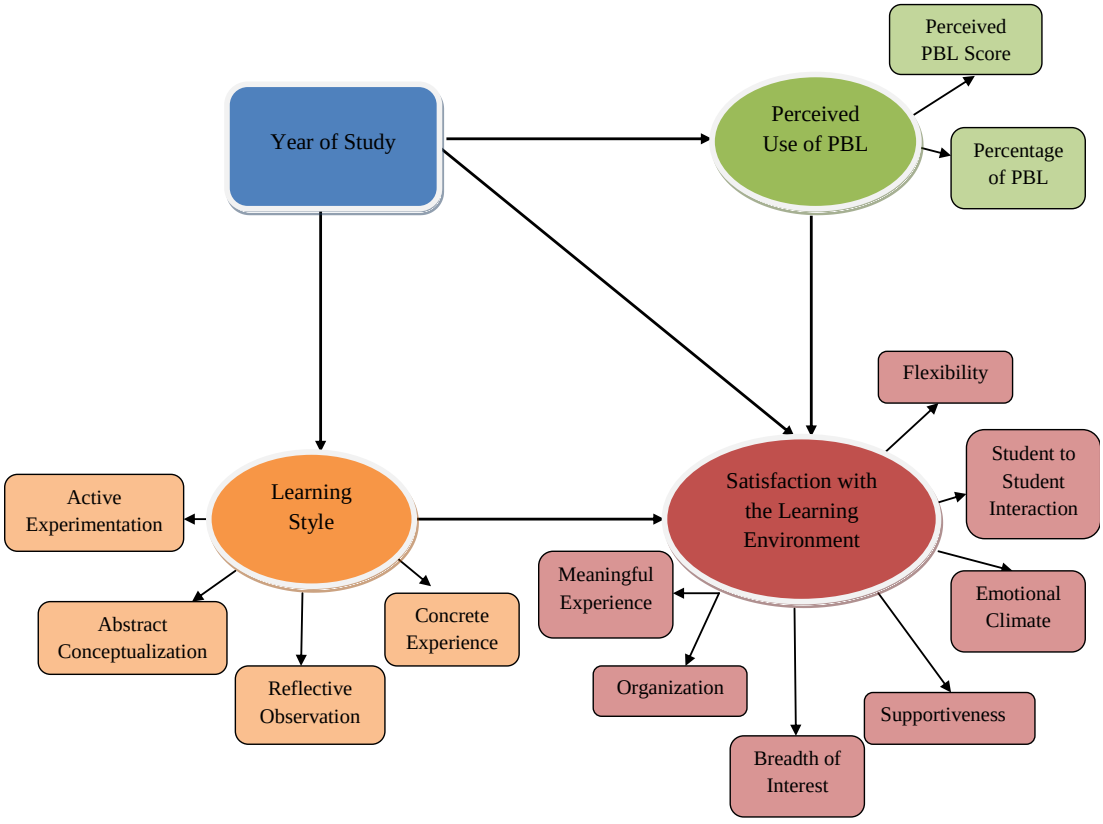


Figure 2. Hypothesized Structural Model

Population and Sample

This quantitative study surveyed genetic counseling students who were enrolled in master's degree programs in genetic counseling. At the time of this study, there were 32 programs accredited by the American Board of Genetic Counseling (ABGC), of which three were in Canada. Each program is a two-year program with varying class size; the smallest ones have four students per class, whereas the largest program has approximately 25 students per class. First- and second-year students were asked to participate in the study.

An electronic message was sent to the program directors of the 32 training programs in order to assess their willingness to disseminate survey materials to their students and to determine the potential number of subjects for each group. The message clearly stated that IRB approval had not been granted at the time of the initial request but would be forthcoming. All 32 of the directors responded favorably to the request and the total number of students that were available for the study was 471. In order to increase the response rate, the participants were given the opportunity to win one of five $20 gift cards to Amazon.com as an incentive to complete the study.

Ethical Considerations

Risks to the subjects participating in this study were perceived to be minimal and were no greater than compared to those of daily living. Potential risk could have been psychological in nature, if a subject had a particular distressful experience during their graduate training. Given the field of genetic counseling is relatively small, many of the program directors are known to the student investigator of this project. Therefore, participants may have been concerned about their confidentiality. They were not penalized for not answering a question or survey and the subjects were instructed prior to the study that they could withdraw from the study at any time.

Participants' confidentiality has been maintained as much as possible, as no personal identifiers were collected. Confidentiality has been maintained in that neither the participants, nor their responses to the survey questions, will be identified in any published work. The surveys will be kept in the private possession of the investigator for three years, per Federal guidelines. After that time, the data will be destroyed. The study was not anonymous as the respondents had the opportunity to obtain an incentive. The

participants were allowed to contact the student researcher via electronic mail if they wished to receive their individual learning style results from the Kolb LSI and/or the incentive.

Benefits for the participants included providing information which could be useful for future students enrolled in graduate training programs in genetic counseling. On an altruistic level, they are giving back to their profession. Prior to participating in the research study, each participant was asked to sign a consent form which delineated the risks and benefits as outlined above.

Instrumentation

Questionnaire. In order to ascertain the desired information, a questionnaire was developed which is comprised of four sections and includes portions that were developed by the researcher and other sections that are publically available inventories. Section One gathered demographic information such as the respondents' age, gender, ethnicity, year in training, current GPA, and past educational experience. It was anticipated that respondents would follow demographic trends as exhibited by the 2012 National Society of Genetic Counselors' Professional Status Survey in which the majority of those in the field are female and are of Caucasian descent, 96% and 92%, respectively (National Society of Genetic Counselors, 2012). Therefore, these characteristics were not useful dependent variables when assessing learning styles. However, years of training has been shown to contribute to learning styles when assessing other professions; therefore, this variable was also assessed for trainees within genetic counseling graduate programs (Mammen, Fischer, Anderson, James, Nussbaum, Bower,& Pritts, 2007; Murphy, Gray,

Straja, & Bogert, 2004). It was unclear whether past educational experience impacts learning style; hence this information was ascertained as a potential independent variable.

Perceived use of practice-based learning. Section two of the questionnaire assessed program instruction from two perspectives in order to evaluate the perceived use of practice-based learning. The first addresses which teaching methods are employed in the training program. Fourteen statements were written which were based on varied teaching techniques that assessed the students' perception about the use of teaching modalities that are used in practice-based learning (Joyce, 2006). A fifteenth statement asked the student to rate their satisfaction with the teaching techniques employed in their program. Respondents were asked to rate each statement based on a four-point Likert scale that ranged from strongly disagree to strongly agree. In addition to rating the aforementioned statements, respondents were asked what percentage of time was spent on didactic versus practice-based learning techniques. This information was used to gather data about techniques used in the classroom in a different manner than the rated perceptions.

Satisfaction with the learning environment. The third section of the student questionnaire assessed student satisfaction with the learning environment by using a modified version of the DSLES. Evaluation of students' perception of the learning environment is commonly conducted by utilizing the Medical School Learning Environment Scale (MSLES) or the related Dental School Medical Learning Environment Survey (DSLES). The student investigator was granted permission by Henzi to use the DSLES to evaluate the learning environment among genetic counseling trainees. The DSLES required minimal changes in order to be used with the group of

students involved in this current study. The word "dentist" was replaced with "genetic counselor"; "dentistry" was replaced with "genetic counseling"; and "oral health care" was replaced with "health care". These modifications resulted in the Genetic Counseling Training Learning Environment Scale (GCTLES), which consists of 55 items rated with the following options: 1 = seldom, 2 = occasionally, 3 = fairly often, 4 = very often, and 5 = insufficient information. The items within the GCTLES ask the respondent to consider each statement and how often they have experienced the action or viewpoint represented therein. The last option, insufficient information, is available should the student feel that they do not have enough information about that specific item to the question and is not scored; therefore, making the overall scale a four-point scale. A modified MSLES and DSLES was chosen as the tool to assess the learning environment as studies have shown that the MSLES and DSLES have high validity and reliability. In addition, the seven subscales of these inventories are very applicable to genetic counseling training programs and provide a comprehensive evaluation of the learning environment.

The three modifications to change the references of dentistry to genetic counseling were not expected to alter the validity and reliability of the DSLES and previous studies have demonstrated that the DSLES has comparable validity and reliability to the MSLES. The modified DSLES was chosen as the tool to assess perceptions of the learning environment for this current study due to the previous studies that demonstrate strong psychometric properties. In addition, the survey has been used to evaluate PBL in several studies and captures data that would not only be applicable to

genetic counseling training programs but can also provide the administrators of said programs with useful information regarding the learning environment.

Marshall (1978) found that the MSLES had high reliability as demonstrated by an alpha Cronbach value of 0.92 overall with a range of 0.85 to 0.70 for the seven subscales. Feletti and Clarke (1981a) assessed the reliability and validity of the MSLES by administering the survey to a total of 277 students in two different Australian medical schools with two different learning environments, traditional versus contemporary. The findings of the study determined that the MSLES scores were more favorable for the students enrolled in the contemporary program. Between the two groups, the overall alpha Cronbach was 0.89 and 0.94 with the range for the subscales consisting of 0.56 to 0.82. Based on these data, the authors concluded that the MSLES has robust reliability data. Construct validity was also determined by comparing the means of the MSLES scores between the two learning environments, which were significantly different between the two groups. Additionally, six of the seven subscales demonstrated significant differences between the two groups. The subscales were also analyzed and yielded results that indicate high validity based on moderate to high correlations with the overall score as well as demonstrating low correlations between the different aspects of the subscales.

A second study by Feletti and Clarke (1981b) measured the reliability and validity of the MSLES by evaluating three psychometric properties - retest reliability, internal consistency, and factorial validity. The data are based on 947 students within four medical schools in Australia who took the MSLES. With regard to retest reliability, 194 students were administered the MSLES two times in a four month period and the

mean scores for the overall score and subscales were relatively consistent. A reliability estimate of 0.75 was found for the overall scores and the subscales' reliability estimates ranged between 0.85 and 0.93. Internal consistency was determined by comparing the scores between the four medical schools. A Cronbach's alpha for the overall score was 0.89 and only slight variations among the subscale scores were noted thereby indicating good internal consistency. Factorial validity studies demonstrated that there was no relationship between the seven subscales as there was a wide range of correlations noted between the subscales. Although the subscales measure a common factor, learning environment, they could be collapsed into one scale; however, student interaction scores generally stand alone. Therefore, the authors conclude that it is best to keep the subscales separate.

Henzi (2005) reported an overall Cronbach alpha of 0.91 for the DSLES and internal consistency of the various subscales as ranging from 0.67 to 0.89. This data is consistent with previous studies demonstrating the psychometric properties of the MSLES. Since the DSLES is a slightly modified version of the MSLES and has demonstrated good reliability and validity, it would stand to reason that the minor modifications made to the DSLES to create the GCTLES would have similar validity and reliability measures.

Learning style. The fourth section of the questionnairewas the completion of the Kolb Learning Style Inventory (LSI) 3.1 in order to ascertain the specific learning styles of the subjects. Respondents were asked to complete this inventory according to the authors' directions. The subjects were asked to submit their completed inventory with the completed questionnaire. The LSI was selected as many of the other inventories that

assess similar concepts regarding learning are based upon Kolb's theory. In addition, the LSI has been used extensively to assess learning preferences in many professions and is a short inventory making it favorable to use. For these reasons Kolb's LSI was chosen for this study. The psychometric properties of the LSI 3.1 are fairly good based on reliability and validity studies. Permission to use the Kolb LSI was granted by Alice Kolb and the Hays Group, the purveyors of the instrument.

While the 4.0 LSI is the most current version of the Kolbs' assessment tool, it was not available for use at the time of this study. Additionally, the psychometric properties have not been published and this version is only available on-line. More importantly, the 4.0 LSI is basically the 3.1 version with an additional scale that measures learning flexibility, which was not a focus of this current study. For these reasons, it was decided that it was best to utilize the 3.1 version for this current study.

In order to assess inherent styles and ways of learning, the Learning Style Inventory (LSI) was developed by Kolb in 1971. The first version of the LSI was a 9-item self-reported questionnaire which required ranking four words which best fits one's learning style. The LSI has been modified over the years to address issues of reliability and validity. The most current version, created in 2005, is the LSI 3.1 which now consists of 12 items. Each word relates to CE, RO, AC, and AE. There are two questions which rate AC-CE (abstract over concrete) and AE-RO (action over reflection). The LSI has been used extensively to assess learning across several disciplines. From its widespread use, learning styles have emerged based on which abilities dominate learning. Studies have shown that individuals have styles which incorporate one dimension from grasping

experience and another from transforming experience. These include diverging, assimilating, converging, and accommodating learning styles.

A person who has a diverging learning style, their dominant abilities lie within CE and RO and is characterized as one who likes to gather information and look at issues from a variety of perspectives, they are imaginative, like to work in groups, and are often involved in the arts. An assimilating learning style is dominated by AC and RO. Learners with this style need to take information and put it into a logical manner. They are more interested in the facts rather than people and learning via lectures is the most helpful to these individuals. People in the sciences and information technologies tend to be assimilators. The converging learning style is grounded in AC and AE abilities. These individuals solve problems by taking theories or ideas and making sense out of them, and they are less concerned with interpersonal issues and focus on technical issues. They learn best by applying theories or conducting experiments and often people who work in technology. The last learning style, accommodating, is dominated by CE and AE abilities and as expected, they learn best by hands-on experimentation. Individuals with this learning style often rely on other's opinions or their own emotions rather than basing decisions on factual information. They prefer to work with others and bounce ideas off of them prior to making determinations. Often these individuals are employed in marketing or sales. (Kolb, Boyatzis, & Mainemelis, 2000; Kolb & Kolb, 2009).Many studies using the LSI only refer to the historical four learning styles of accommodating, converging, diverging, and assimilating. These four styles are represented in figure 3.

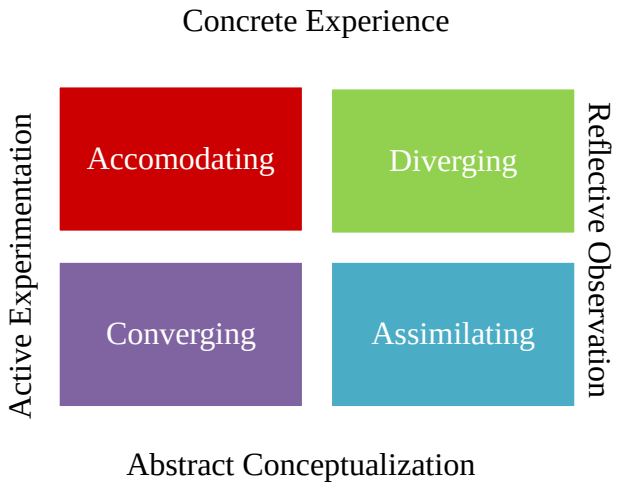


Figure 3. The Historical Four Kolb Learning Styles

Although most researchers who assess learning styles based on Kolb's model utilize the four learning styles, more recent research by the Kolbs has shown that there is a benefit to further refining the learning styles into nine expanded styles (Kolb & Kolb, 2005a). This is based on the recognition that some individuals reveal a preference for learning according to one of the four modes that result in these four styles: experiencing (CE), reflecting (RO), thinking (AC), and acting (AE). The experiencing style demonstrates a preference for CE with the ability to balance AE and RO. Thus, these individuals use their life experiences as the basis for learning while using their feelings about others. They are skilled at creating interpersonal relationships and are creative and innovative thinkers. Individuals with a reflecting style are deeply rooted in RO while balancing CE and AC. Observation is the basis for learning, and these individuals revel in looking at situations from different perspectives and like to ponder the underlying reason forcertain circumstances. Reflecting persons can be creative but are not implementers; however, they are also organized and can analyze data. The thinking style

is based on AC while balancing AE and RO. These individuals use theories and concepts to learn and rely on data and numbers rather than emotion. Typically, these persons prefer to work alone and think ideas over before acting. Lastly, the acting style is dominated by AE with using a balance between CE and AC. These individuals are problem solvers while at the same time taking people's feelings into account. They often find themselves in leadership roles due to their ability to get things done. A ninth style has emerged in which a person learns by balancing all four modes, thus this style has been named as balancing.A person with a balancing learning style sees many aspects to a situation and help people with varying styles come to consensus. However, they often have difficulty reaching their decisions although they change their learning style based on what is needed at that specific time (Kolb, Boyatzis, & Mainemelis, 2000; Kolb & Kolb, 2005a; Kolb & Kolb, 2009; Kolb & Kolb, 2011).Figure 4 depicts the current nine Kolb learning styles. Of note, the historical terms of accommodating, diverging, assimilating and converging have been renamed to initiating, imagining, analyzing, and deciding, respectively.

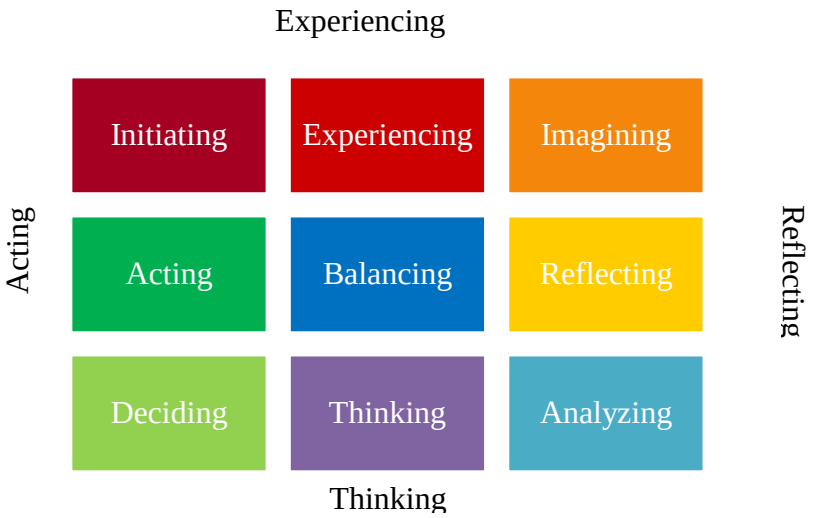


Figure 4. Nine Learning Styles of Kolb's LSI

The LSI 3.1 is a 12-item questionnaire that requires the respondent to rank four sentence endings that correspond to each of Kolb's four learning modes (experiencing, reflecting, thinking, and doing) (Kolb & Kolb, 2005a). The selection of answers is a forced-choice format as the respondent must submit a one through four ranking for each question. According to Kolb and Kolb (2005b), the forced choice format is the best manner to provide the most information regarding intra-individual differences for the learner rather than inter-individual comparisons which are often determined via a Likert-type scale. The responses to the 12 questions allows for stratification into the four learning orientations (CE, RO, AC, and AE), as well as for the two combination scores of AC-CE and AE-RO.

In order to determine the scoring of the learning styles the normative group was based on 6,977 LSI scores from individuals of both genders, ages that range from less than 19 years old to greater than 54 years old, and varied educational levels. From this cohort of individuals percentiles were devised in order to create norms and to allow comparisons among individual scores, as well as to determine "cut points" for the learning styles (Kolb & Kolb, 2005b). In order to determine the four historical learning styles from an individual's learning orientations, the AC-CE and AE-RO scores are divided at the fiftieth percentile of the total of the normative group. The following cut points have been established: AC-CE scale is +7; AE-RO scale is +6; accommodating style is an AC-CE raw score of ≤ 7 and an AE-RO raw score of ≥ 7; diverging style is AC-CE ≤ 7 and AE-RO ≤ 6; converging style is AC-CE ≥ 8 and AE-RO ≥ 7; and assimilating style is AC-CE ≥ 8 and AE-RO ≤ 6. However, in order to determine the nine learning styles, the normative group is divided into thirds for the two normative groups,

AC-CE and AE-RO. The following cut points have been established: on the AC-CE scale, the concrete area is defined as ≤ -1 and the abstract region as ≥ 12; on the AE-RO scale the active area is defined as ≥ 12 and the reflective region as ≤ -1. Thus, each individual received one specific, dichotomous style. The scoring for this inventory was conducted by hand and the raw scores were subsequently imported into SPSS. Data analysis was conducted to determine both the four styles and the nine styles as most of the literature reports data and results in relation to the historical four learning styles and allowed for comparison with other health care professions. Calculation of the nine styles allowed for comparison within this study population with the four styles as well as adding to the literature that discusses the nine styles.

Several studies have been conducted on the LSI 3.1 to determine internal consistency reliability among various groups of individuals who have taken the LSI. Cronbach's alpha coefficients were calculated for each of the four learning orientations with the following results: CE ranges from .56 to .81; RO ranges from .67 to .81; AC ranges from .71 to .84; and AE ranges from .52 to .84. Three studies calculated the Cronbach's alpha for the combined score which range from .77 to .83 and .82 and .84 for AC-CE and AE-RO, respectively (Kolb & Kolb, 2005b). Two test and re-test studies have been published. One conducted by Veres et al. (1991) found correlation scores of greater than 0.9 on repeat testing; however, another study by Ruble and Stout noted a Kappa coefficient of 0.36 which indicated that 47% of students changed their learning style on repeat testing. While these two studies had varied outcomes, Kolb and Kolb propose that changes in learning style are somewhat expected due to extrinsic factors (Kolb & Kolb, 2005b). External validity studies have been performed to determine if the

latest version of the LSI, version 3.1, maintains its rigor when compared to previously validated studies for earlier versions of the LSI. Kolb and Kolb (2005b) state the data is similar when comparing LSI 3.1 to earlier versions of the inventory.

Data Collection

Recruitment of participants was conducted by sending an electronic mail message to the program directors of these 32 graduate programs asking for their assistance in obtaining subjects for this study. Survey packets for the studentswere mailed to each program director which were disseminated to their respective students. Each questionnaire packet consisted of the following items: a consent form, the questionnaire with the Kolb LSI 3.1, and two pre-addressed stamped envelopes, one to return the consent form and the other for returning the completed survey.

In order to calculate response rate and tracking responses, each distributed packet was assigned a study identification coded by graduate program. Participants were asked to mail back a signed consent form in a separate pre-stamped envelope from the completed study inventories. Paper and pencil administration of the various assessment tools versus a web-based approach was chosen as to simplify administration of several inventories and to optimize the study response rate.In the cover letter describing the study, the participants were informed to send an electronic mail message to the student researcher if they desired to be enrolled in the drawing for the gift card incentive and provide their name and address in order to the respond to the winning participants.

Data Analysis

Overview. In order to answer the research question, *"Do trainees' learning style, year of study, and perceived use of practice-based learning have effects on the*

satisfaction with the learning environment?" structural equation modeling (SEM) was conducted. SEM determines strength for hypotheses about relationships between variables based on theoretical as well as on empirical data (Byrne, 1998; Maruyama, 1998). For example in regard to this current study, it has been established that year of study influences learning styles, an established relationship. However, it had not been previously demonstrated that learning styles influence satisfaction with the learning environment which was one of the hypotheses for this study that is theoretical in nature. The major benefit of SEM is that it allows one to determine the impact of hypothesized relationships between two variables directly, as well as identifying if there are mediating, or intervening variables, between two variables (Maruyama, 1998). SEM analysis allows one to assess multiple independent variables and their relationship with one or more dependent variable. Covariance is the principle statistic of SEM which leads to two primary goals: (1) among observed variables, recognize patterns of covariance and (2) with the proposed model, delineate as much of the variance as possible (Bowen & Guo, 2012; Kline, 2011). There are two components to SEM, a measurement model which utilizes confirmatory factor analysis and a structural model that uses path analysis. SEM merges multiple statistical analyses including factor analysis, path analysis, ANOVA, and multiple regression (Bowen & Guo, 2012; Hoyle & Smith, 1994; Hox & Bechger, 1998).

SEM defines variables slightly differently than other statistical analyses. Exogenous variables are those that are not influenced by other variables, synonymous with independent variables, whereas endogenous factors, or dependent variables, are those that are impacted by other variables (Byrne, 1998). In this study, years of study may be an exogenous factor but satisfaction with the learning environment is an

endogenous factor as it could be influenced by years of study and/or perceived use of practice-based learning. In addition, it is important to recognize that SEM takes into account latent variables and manifest variables as part of the analysis. Latent variables are not directly measured and are represented by ovals in the visual depiction versus a manifest variables are those which are measured and define the concept being represented and are depicted by rectangles (Byrne, 1998). For example, in this study, learning style is a latent variable whereas the four modes being measured by the LSI are manifest variables. SEM also allows for computation of intervening relationships. For example in this study, it is possible that perceived use of practice-based learning is a mediating variable between years of study and satisfaction with the learning environment. Therefore, one can account for interrelationships between more than one variable as well as determining directionality of variables simultaneously (Hoyle & Smith, 1994).

The primary estimation tools utilized in SEM is maximum likelihood which is the default in most SEM computer programs. Maximum likelihood (ML) "describes the statistical principle that underlies the derivation of parameter estimates; the estimates are the ones that maximize the likelihood (the continuous generalization) that the data (the observed covariances) were drawn from this population" (Kline, 2011, p. 154). ML assumes normality of the endogenous variables and that they are continuous variables. If neither of these criteria is met, then other models of estimation are necessary to employ. Computer programs initiate ML estimation and then continue to improve on this initial result by performing repeated calculations. There are several important assumptions made for ML estimation besides normal distribution and use of continuous endogenous

variables, which include there are no missing data and that the model has been correctly specified. This latter criterion is the most crucial according to Kline (Kline, 2011).

There are several computer programs that can be used for SEM. For purposes of this study, SPSS AMOS (Analysis of Moment Structures) was utilized. Once the data were entered, AMOS created path diagram models that could be modified and labeled as necessary. Statistical analyses were then conducted to further analyze the generated model.

Structural Equation Modeling

According to Kline (2011), there are six steps to SEM analyses. Figure 5, which is adapted from Kline (2011), depicts the process and steps taken from beginning to completion of SEM in order to help the reader gain a better understanding of the entire scope of such an analysis. What follows next is a description of each step of SEM analysisin order to provide details of the structural equation modeling process.

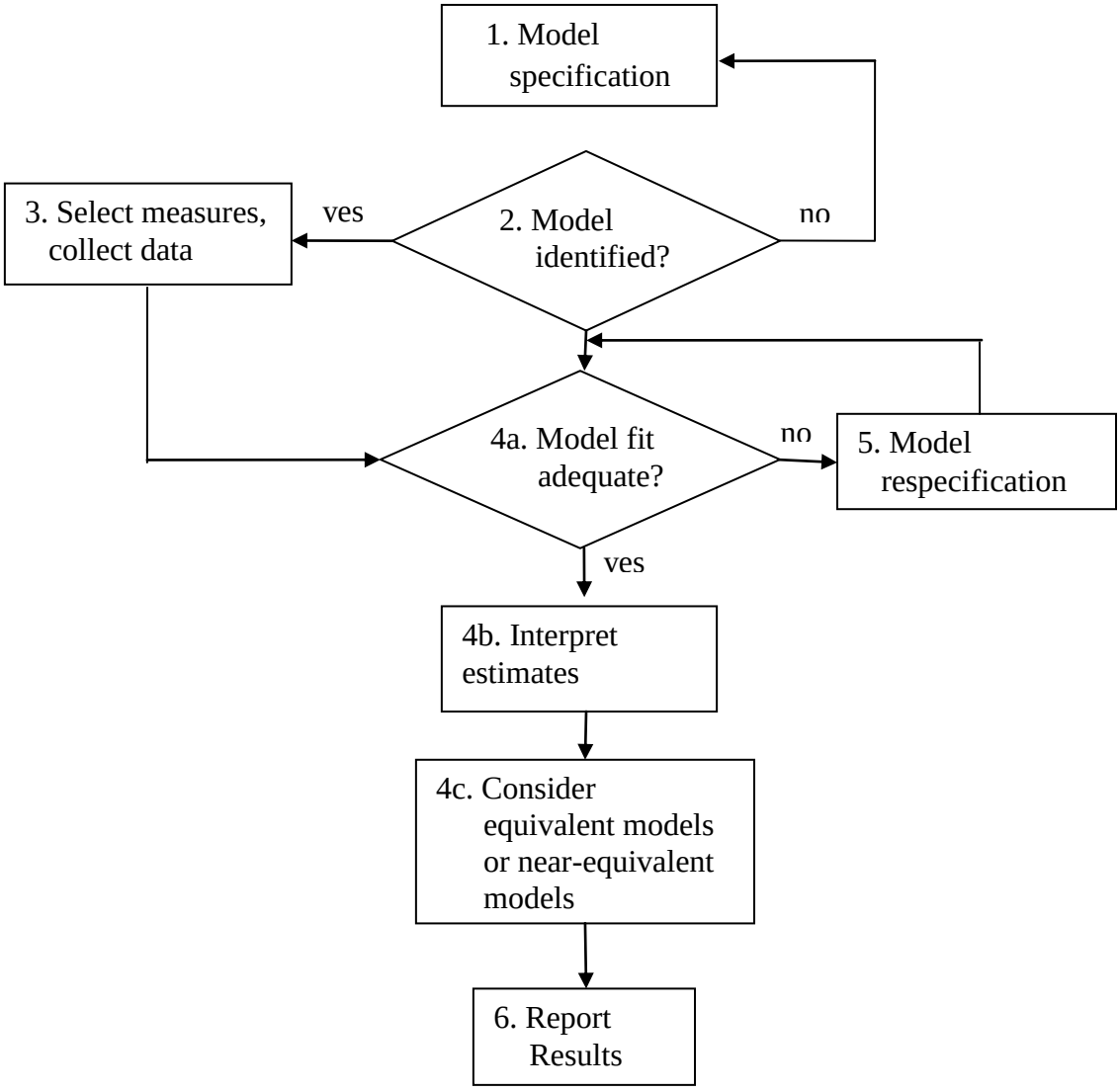


Figure 5. Flowchart of Structural Equation Modeling Process

Specification. The first step in SEM is to determine or specify the relationships between variables that are suspected to exist, which includes both latent and measured or observed variables. Specification is the most crucial step in the process as the results that emerge from the model are based on the relationships set forth initially. One aspect to specification includes the number of observations that exist for analysis. The number of observations is not related to sample size; rather it equals the number of observed variables multiplied by the number of observed variables plus one divided by two.

Degrees of freedom is the difference between the number of observations and the number of parameters (Bowen & Guo, 2012; Kline, 2011). A count of the parameter estimates are calculated by summing the number of factor loadings, variances, interfactor covariances, and error variances.

Model identification. The second step is identification which is critical for the analysis to succeed. "A model is identified if it is *theoretically* possible for the computer to derive a unique estimate of every model parameter" (Kline, 2011, p. 93). Respecification is required if the model is not identified. In order to identify an analysis, two conditions must be met. First, the degrees of freedom must be at least zero. If there are more estimated parameters compared to observations this leads to a model that cannot be identified. Second, each latent variable must have an accompanying scale (Bowen & Guo, 2012). Just like each latent variable requires a scale, so too does each error term. The regression paths of measurement errors to scale items are also assigned a scale which is usually set to equal 1 (Kline, 2011). Therefore, the question of identification is a mathematical matter and is not dependent on data as it is simply the symbolic representation of the covariance matrix. Thus, model identification should be conducted prior to collecting data. In unique cases, a model mathematically identified is not theoretically identified and will not converge to a solution.

Data issues. The third step in a SEM analysis includes selection of measures and data collection. Several aspects of the data need to be assessed before entering into a SEM analysis. First, collinearity, the idea that unique variables measure the same factor, should be evaluated. Collinearity can be evaluated in various manners such as calculating a squared multiple correlation, determining tolerance, or computing the

variance inflation factor (VIF). Multivariate collinearity is demonstrated by each of these methods if the resultfor multiple correlation equals> 0.90, tolerance equals< .10, and VIF equals> 10.0. If collinearity is identified, then the redundant variables can be collapsed into one variable or eliminate one of the redundant variables from the analysis. Second, as in most research there can be outliers within the data. Outliers can be detected by certain computer programs that perform SEM, such as AMOS. Another way to identify outliers would be to determine the Mahalanobis distance statistic for those variables that have *p*-values that are extremely significant ($p < 0.001$). This statistic is the distance in standard deviation units between a set of scores for an individual case and the sample means for all variables. The Mahalanobis distance is a chi-square distribution and the degrees of freedom are equal to the number of predictor variables (Bowen & Guo, 2012; Kline, 2011). Should outliers be noted, then those values can be recoded or the case with the outliers could be eliminated. Third, the manner in which missing data will be handled must be addressed. Given that most missing data are not intentional or ignorable, it is thought that an amount of less than 5% of missing data for a single variable with a large sample is tolerable and will not skew the outcome of the analysis. There are two types of ignorable missing data, missing at random (MAR) and missing completely at random (MCAR). MAR means that missing data for a particular variable are not related to the overall score for that variable and is due to chance alone. However, MCAR occurs if the missing data are unrelated to any variable in the data set (Bowen & Guo, 2012; Kline, 2011). It is difficult to determine the reason for missing data and there is no perfect way to correct for missing data; however, one can create a dummy code variable for missing data or some computer programs can assess patterns of missing data. Kline (2011)

contends that it is best to simply try to understand the reason for missing data and explain this in the interpretation of the results. Additionally, the analysis can be run with both the missing data included and excluded if it appears the missing data will have an impact on the results. Missing data can be dealt with in several manners; however, two common methods include eliminating incomplete cases or replacing missing data with a single calculated score, also known as single imputation. Single imputation can be performed in various ways such as replacing the missing observation with the overall sample mean for that question (mean substitution) or analyzing responses from that individual and makes an assumption as to how that subject would answer the unanswered question and enter that value for the particular observation (regression-based imputation) (Kline, 2011). Imputation is not recommended as this will artificially deflate the standard error. However, in AMOS the full information maximum likelihood (FIML) method provides complete results in the presence of missing data and all standard errors are adjusted properly when using FIML (Kline, 2011).

SEM assumes that the continuous variables follow a normal distribution, also known as multivariate normality. If the data are skewed or kurtosis is present, and it is determined that the data are non-normal, corrections should be made to make the data follow a more normal distribution. Transformations can be conducted that employ mathematical functions to convert original scores to those that are more normally distributed. Depending on the distribution problem attempting to be solved, various techniques can be performed to normalize the data. However, transformation of data is not without faults. For example, if the data are severely non-normal, the data may not be

able to be transformed. Additionally, transformation may not uphold the original scale of a particular variable and the meaning of the scale may be lost (Kline, 2011).

One last problem related to data that needs to be addressed in SEM is the concept of "ill-scaling." This occurs when the variances between the variables are greatly discrepant. If the ratio between the largest and smallest variance is more than 10, then the covariance matrix is said to be ill-scaled (Bowen & Guo, 2012; Kline, 2011). In order to correct for ill-scaling, one of the variables can be adjusted by multiplying by a constant to minimize the disparity between the variables. While this modification alters the mean and variance, it will not change the variable's correlation with the other variables.

Measure selection. The other component of step three in the SEM process is the selection of measures. As with other statistical analyses, it is important to select and utilize measures that have strong psychometric properties. Reliability and validity should be demonstrated for the chosen measures and described in the study's report. If the measures used have poor psychometric properties, the validity of the study's findings may be compromised. The psychometric properties of the various measurement tools utilized in this particular study are addressed earlier in this chapter.

Model estimation. After data has been collected, the fourth step in the process is to determine how well the model explains the data. If there is not a good fit, then the model needs to be respecified (step 5) and the process begins again and the data is analyzed once again. If the fit is acceptable, the next step is to determine and interpret the parameter estimates. The final solution for the model is determined when the discrepancies are very small between the hypothesized model and the computed model.

Although a model is determined to have a satisfactory fit, it is understood that there are several other models that may be just as appropriate

As part of the estimation process, one must determine how well the model fits the data. There are different ways to establish fit, one of which is a model test statistic that determines if covariance matrix for the model proposed by the researcher is similar enough to the calculated covariance matrix for the study's sample. If the two are not close, then the data negates the model. Although in most statistical analyses the goal is to reject the null hypothesis, in SEM the goal is to accept the null hypothesis. Therefore, with SEM the ideal outcome is to reduce the discrepancies between the data and the implied model (Bowen & Guo, 2012; Kline, 2011). A second method of estimating the fit is approximate fit indexes which differ from model test statistics in that sampling errors and true covariances are not differentiated from one another as indicative of poor model fit. Additionally, approximate fit indices generate continuous measures regarding the model-data fit and do not provide data to allow for rejecting or accepting the null hypothesis.

There are several fit indices that can be used in SEM. Model chi-square analysis (χ^2) is one model test statistic in SEM. χ^2 is the product of sample size minus one and the minimization value (either ML or WLS). The degrees of freedom is equal to the proposed model. If χ^2 equals zero, then the model fits the data exactly; however, the higher the value of χ^2, the poorer the model fit. If the χ^2 statistic is not significant, than it can be concluded that model fits the data. However, χ^2 statistics are heavily influenced by sample size. In large sample sizes, χ^2 are almost always statistically significant and in

small sample sizes, χ^2 is often statistically insignificant. Thus, other goodness of fit indices are recommended.

Another often used fit statistic is the Root Mean Square Error of Approximation (RSMEA) which is an approximate fit index. RSMEA is based on recognition that a perfect model fit is difficult to achieve; therefore, approximating how well a model fits the data may be sufficient (Hox & Bechger, 1998). A value ≤ 0.05 indicates a close fit, values of 0.05 to 0.08 imply a reasonable error of approximation. When calculating RSMEA it is important to be cognizant of the confidence interval as RSMEA is prone to sampling error. One concern with RSMEA is that it is impacted by the number of variables in the model, in that larger models may be rated more favorably compared to smaller models.

Two other fit indices include Jöreskog-Sörbom Goodness-of-Fit Index (GFI) and the Bentler Comparative Fit Index (CFI). The former "is an absolute fit index that estimates the proportion of covariances in the sample data matrix explained by the model" (Kline, 2011, p. 207). With this index, the best fit is demonstrated by a value of 1.0. One limitation of GFI is that it is affected by sample size, with the mean value being directly correlated to the sample size. The CFI is a comparative measurement of the researcher's model and the baseline model. A third fit index is the Tucker Lewis Index (TLI) which is an incremental fit index. This index was created to evaluate exploratory factor analysis models that use maximum likelihood estimates (Bentler & Bonett, 1988). For all of these indices, in general, a value of ≥ 0.95 indicates an acceptable fit (Bowen & Guo, 2012; Hox & Bechger, 1998; Kline, 2011).

Power. For purposes of power analysis for SEM, it is important to determine how well the data fit the model. MacCullam, Browne and Sugawara (1996) stated that power for SEM is related to the degree of the fit of the model and one can set the degree as close, not close, or exact. Effect size (ε) is more difficult to predict in SEM as there are multiple equations determined in the analysis; however, it is calculated by the RSMEA (Bowen & Guo, 2012). For close (H_0: $\varepsilon \leq .05$) and exact fit (H_0: $\varepsilon = 0$) hypotheses, low power would lend itself to supporting the researcher's model; however, for the not close fit (H_0: $\varepsilon \geq .05$), a low level of power negates the researcher's model (Kline, 2011). MacCullam, Browne and Sugawara have established specific tables for estimated power for each of the three levels of fit (Bowen & Guo, 2012; Kline, 2011; MacCullam, Browne & Sugawara, 1996). Power is dependent on three variables, sample size, degrees of freedom, and degree of fitness (MacCullam, Browne & Sugawara, 1996). Therefore, it is still possible to determine the required sample size to reach a power of 0.80, based on the recommendations by Cohen (1992).

Equivalent and near-equivalent models. Once the model has been estimated the next step in the SEM process is to determine alternate pathways that produce the same covariances. These equivalent models should have the same $\chi^2$and fit statistics as the original model. Since these models are all similar in their statistical findings, background theory then has a clear role to play in explaining why the chosen model ispreferred. Near-equivalent models do not yield the same statistics rather almost the same results are generated. Because of the nature of the results for near-equivalent models, the potential exists that these could be numerous compared to equivalent models and could raise questions about to the validity of the study. When reporting results, it is incumbent on

the researcher to state why their final selected model is the one of choice over the other models.

Summary

In an attempt to describe the factors that influence the satisfaction with the learning environment within genetic counseling training programs, structural equation modeling was used to determine relationships with several variables, including learning styles, year of study, and perceived use of practice-based learning. Since several of these variables had not been explored previously, the hypothetical model was tested to determine if the independent variables (exogenous variables) influence the dependent variable (endogenous variable), satisfaction with the learning environment as suspected. Statistical analyses were also employed to classify learning styles of students affiliated with the 32 genetic counseling training programs across North America.

This is the first study that evaluated how trainees within genetic counseling training programs learn and the perceptions regarding the teaching techniques employed within these programs. Additionally, student satisfaction from the perspective of the learning environment had not occurred within this population. The data gathered from this study provides novel information that has the potential to assist program directors involved with the training of genetic counseling students gain a better understanding of the perceptions characteristics of their students as it pertains to learning and teaching methods. These data, in turn, may present program administrators an opportunity to assess and evaluate if changes in the classrooms of the genetic counseling training programs would be beneficial to improving student learning and satisfaction.

CHAPTER IV

RESULTS

This study set out to determine ifgenetic counseling trainees' learning style, year of study, and perceived use of practice-based learning have effects on satisfaction with the learning environment. The results from the study are presented in several sections in this chapter. First, the demographics of the study population is presented, followed by an exploration of the data as determined by the various subsections of the study's survey. The order of reporting of the exploratory data will follow in the manner of the findings related to program instruction, the data revealed from the Genetic Counseling Training Learning Environment Scale (GCTLES), and the outcomes of the Kolb Learning Style Inventory. Next, the findings from the structural equation modeling are presented. The chapter concludes with the results for the research question and five hypotheses proposed for this study.

Descriptive Characteristics of Respondents

Participants were recruited from the 32 genetic counseling training programs that were accredited by the American Board of Genetic Counseling at the time of this research study. Of the potential 468 trainees enrolled in the various programs, 271 responses were received, which is a 57.9% response rate. Of interest, one of the 32 programs that

had four enrolled trainees submitted no responses, and the one program that had 100% response rate was the institution affiliated with the student researcher. In general, the makeup of the sample population mimics the data from past National Society of Genetic Counselors Professional Status Surveys, indicating that this study sample is representative of the genetic counseling profession.

Age of participants. Figure 6 depicts the frequencies of the ages of the respondents by percentage. The youngest trainee was 21 years old (n=1), and the oldest trainee was 54 years old (n=1). The majority of respondents were 22 years old to 26 years old, comprising approximately 82% of the study population.

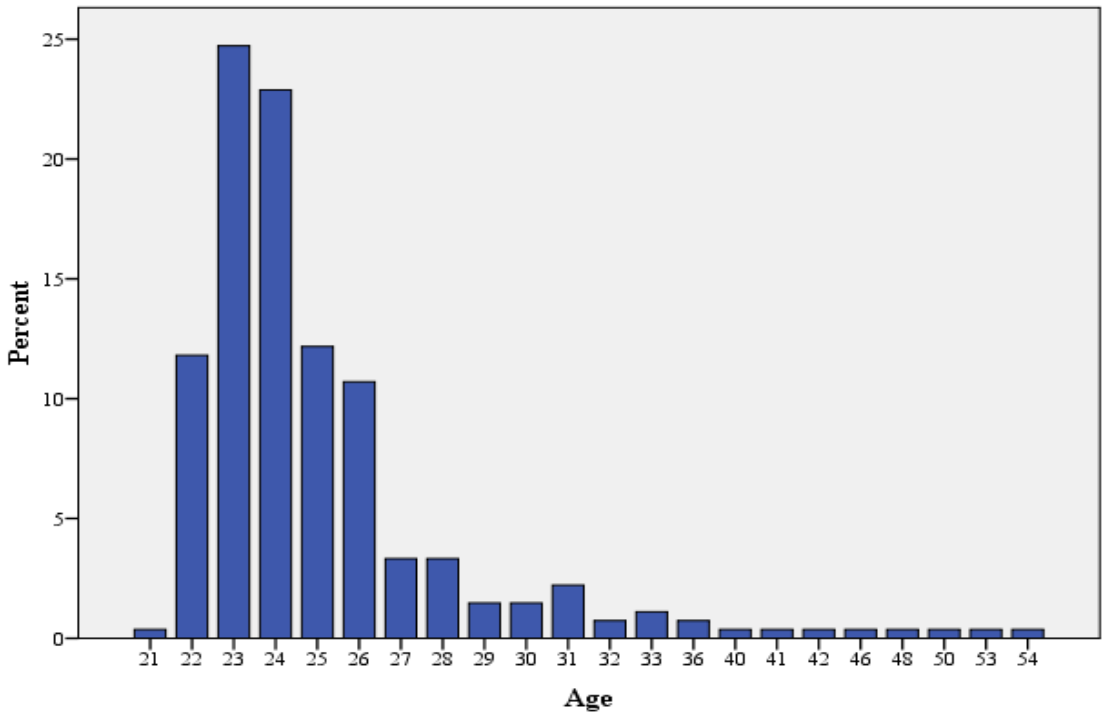


Figure 6. Ages of Respondents

Participants' race. Respondents had the opportunity to report more than one race; however, the majority (~94%) of subjects reported only one race. Of those who indicated having only one race, 232 (91.34%) of the respondents reported being Caucasian, and the second most common reported race was Asian by 7.48% (n=19) subjects. Two individuals reported being of each African-American and Latino ethnicity. The remaining eighteen (6.64%) participants reported having more than one race, with the most frequent ethnicities being Asian and Caucasian by six (2.21%) individuals. Four (1.48%) people reported they were of Caucasian/Latino background. Each of the following racial combinations was reported by one respondent: African American/Caucasian, American Indian/Caucasian, Caucasian/Mediterranean, Caucasian/Pacific Islander, Asian/Indian, African American/American Indian/Caucasian, Caucasian/Mixed and Mixed. Overall, the study population was racially homogeneous.

Participants' year of study. The number of trainees in their first year of study equaled 145 (53.5%), and the number of second year trainees was 124 (45.8%). There were 2 individuals who reported being in their third year of study. Given the low number of respondents in this category, these two subjects were merged into the second year cohort as described in the methodology chapter. Therefore, the final number of second year trainees was 126 (46.5%).

Program affiliation. In addition to year of study, participants were asked to state which school their graduate training program is housed in so that the data could be analyzed to determine if program affiliation made a difference in teaching techniques employed within the programs. The responses to this question are summarized in table 1. Nearly half of the programs reside in a graduate department, whereas approximately 38%

are in medical schools, thus these two departments account for over three-fourths of the programs' affiliations.

Participants' grade point averages. Respondents were asked to report their grade point averages (GPAs) in order to capture additional data regarding the study population. Approximately 17 percent (n=46) of the subjects did not report a GPA allowing for evaluation of the remaining 225 subjects' responses. Of this remaining group, the most commonly reported GPA was 4.0 by 23.5% (n=53) of respondents. Table 2 reports the data about the reported GPAs and demonstrates that 66% of the respondents have a GPA of 3.76 or higher indicating this study population is highly proficient in academics.

Table 1

Graduate Training Program University Affiliation

Program's School Affiliation	Frequency	Percent
Medical	102	37.6
Public health	16	5.9
Graduate	123	45.4
Health & human sciences	10	3.7
Health professionals	7	2.6
Natural sciences	2	.7
Extended education	3	1.1
No answer	8	3.0

Table 2

Grade Point Averages of Respondents

GPA	Frequency	Percent
3.0 - 3.25	7	0.03
3.26 - 3.5	29	12.9
3.51 -3.75	39	17.3
3.76 – 4.0	150	66.7

Participants' educational background. In order to further describe the sample population, questions were posed about previous education and degrees obtained, as well as if the subjects were the first in their immediate family to obtain a four-year degree or a graduate degree. Approximately 12% (n = 34) were the first in their family to obtain a four-year degree, and 44% (n = 119) were the first in their family to attain a graduate degree. Eighty-eight of the subjects had one bachelor's degree, 10% had a second bachelor's degree, ~11% had a master's degree and two individuals (0.7%) had a PhD. For the first degree, 81.5% (n=221) of the degrees were based in the hard sciences such as biology, genetics, or chemistry. Twenty-eight (10.3%) of the subjects had a degree in the behavioral sciences such as psychology or social work. An additional 7.38% (n=22) of the respondents held a degree in the liberal arts; for example, education, theater, religion or marketing. Of those receiving a second degree (n=56), 35 (62.5%) of the degrees were in the hard sciences, 13 (23.2%) were in psychology, and the remaining 8 (14.3%) were in the liberal arts. Participants were asked if entering the genetic counseling training program was a change of career, and 22% of the respondents indicated that by becoming a genetic counselor was a career change for them.

General satisfaction with training and personal happiness. Two questions were asked regarding satisfaction and happiness. The first of these two questions inquired whether first year students planned on returning to their respective programs in their second year. As such, this question was only applicable for the 146 first year respondents. Of these, 143 (98%) stated they planned on returning, while three participants were undecided. The second question asked the respondent to rate how much they agreed with the following statement: "I am happy where I am in my personal life." Of the 270 individuals who answered this question, 91.9% agreed to some extent (slightly, mostly or strongly) whereas 8.1% disagreed at some level. Interestingly, each of the three participants who were undecided about returning for their second year reported some level of agreement that they are happy both in their personal lives and in general. This question was asked to determine if overall dissatisfaction in life also translated into dissatisfaction with the learning environment. Since only a few individuals (n=22) were not happy, this variable was not used in further analysis as power would be low.

Exploration of the Data

In order to perform comparisons between groups prior to the structural equation modeling, initial analyses of the data were conducted through chi-square tests and *t*-tests. Therefore, the following sections explore the data from this standpoint and evaluates the data that is not included in the structural equation modeling. In addition, this initial analysis allowed for determination if the variables would be valid in the structural equation modeling.

Program Instruction.

Teaching techniques. The second section of the survey was aimed at getting a sense of the various teaching techniques employed in the respective training programs and the amount of practice-based learning techniques used.

Table 3

Comparison of Means of Teaching Techniques Between First and Second Year Trainees

Teaching Technique	First Year Mean	Second Year Mean	*T*	*P*
Small Groups	3.43(.725)	3.37 (.616)	0.81	0.42
Brainstorming	3.63(.587)	3.66(.555)	-0.31	0.76
Reflection	3.70(.554)	3.70(.539)	-0.01	0.99
Lecture	3.72(.471)	3.66(.507)	0.95	0.34
Role Plays	3.48(.602)	3.54(.561)	-0.96	0.34
Journaling	2.57(.979)	2.55(1.01)	0.14	0.89
Observations	3.46(.746)	3.44(.666)	0.21	0.83
Open Discussion	3.81(.461)	3.78(.552)	0.50	0.62
Case Examples	3.61(.531)	3.58(.571)	0.34	0.73
Self-Directed Learning	2.85(.802)	2.82(.777)	0.39	0.69
Oral Examinations	2.29(.945)	2.15(.951)	1.21	0.23
Essays	3.22(.712)	3.16(.797)	0.66	0.51
Field Trips	2.51(.961)	2.50(.947)	0.15	0.88
Problem-based Learning	3.17(.667)	3.20(.665)	-0.46	0.64

Notes. Degrees of freedom = 268. Standard Deviations appear in parentheses next to the means.

Fourteen questions were utilized to assess how often respondents agreed that certain teaching practices were used in their program's coursework. Participants were given a Likert scale of 1 to 4, corresponding to strongly disagree, disagree, agree, or strongly agree. Therefore, the higher the score, the more often these techniques were used in the program. The ratings for each teaching technique broken down by year of study are represented in table 3.Lecturing, or didactic practices, had a mean of 3.70, indicating this technique is used quite often. Of the PBL teaching techniques used in the classroom, the highest teaching modality was "open discussion is encouraged in the classroom" with a mean score of 3.79 for both trainees in both years of training combined, followed by brainstorming with a mean of 3.60. The majority of the variables had mean scores between 3.0 and 3.79; however, four teaching techniques had mean scores between two and three indicating less use of these teaching modalities. These included self-directed learning, journaling, field trips, and oral examinations with means of 2.84, 2.56, 2.51 and 2.23, respectively. An independent *t*-test for each of the teaching modalities showed no significant differences seen between the two cohorts indicating that students perceive similar types of teaching modalitiesregardless of year of study.

Satisfaction with teaching techniques. One question in this section inquired about overall satisfaction with the teaching techniques used in the respondents' program. Out of the 270 subjects that answered this question, an overwhleming majority were satisfied with the teaching modalities used within their programs. Ninety-three percent of respondents (n=253) either strongly agreed or agreed with the statement "I am satisfied with the teaching techniques used in my program." However, three individuals (1.1%) scored this question as neither agree or disagree by giving a score of 2.5, and the

remaining 5% (n=14) of the participants disagreed or strongly disagreed with that statement. The mean score for first year trainees was 3.48 and the second year students had a mean score of 3.36. Thus, the overall majority of individuals were satisfied with the teaching employed within their programs; however, approximately 6% of the study sample was dissatisfied.

An independent *t*-test was performed to determine if there was a statistically significant difference between first and second year students and their satisfaction with the teaching methods employed within their training programs. The analysis did not reveal a significant difference between the two groups, $t(268) = 1.57$, $p = 0.105$.

Percent of time spent on practice-based learning. The last question in this section of the survey asked the participants to denote what percentage of time was spent, in their opinion, on lectures or didactic teaching versus practice-based learning (PBL). It should be noted that the participants were not provided a definition of PBL in order to assist in answering this question. This question was posed to determine if there are perceived differences between first- and second-year trainees, as well as to provide another manner of checking the perceived use of teaching techniques compared to the fourteen questions discussed above. On average, the respondents reported that didactic teaching is used 64% of the time and PBL techniques are used 36% of the time. An independent *t* –test did not demonstrate a statistically significant difference between first- and second-year students regarding the perceived amount of didactic teaching versus practice-based learning, $t(268) = .66$, $p = 0.51$.

In order to determine an average score of PBL instruction, the mean of thirteen of the fourteen questions that evaluated the various teaching methods used in the classroom

was calculated. The answer to how much lecture was used in the classroom was excluded from this mean score so that the average PBL score only included responses to PBL techniques. A correlation analysis was conducted to investigate how well the answers to the amount of PBL teaching techniques used correlated to the perceived percentage of PBL as a way of an internal validation. This analysis demonstrated that the average score of PBL techniques used did correlate to the perceived percentage of PBL used in training, $r(257)= 0.256$, $p< .01$. Although this correlation was statiscally significant, it is a fairly weak correlation. In addition, a visual exploration of the data showed that there was no linear correlation between these two variables. Furthermore, there was no consistency among the reported percentages among students within the same training program, suggesting that the question asking for percentages may have been too subjective and possibly not valid. For example, for participants from one specific training program, the percentage of lecture used ranged from 30% to 80%. This type of discrepancy was seen consistently amongst all the programs. Therefore, one of these variables is not likely representative of actual use of PBL in the classroom given the discrepancy between the two variables. Given the average score of PBL used in the classroom was determined by objective means by answering a series of questions, it is likely that this measurement is more valid compared to the reported percentages which was a subjective answer.

Genetic Counseling Training Learning Environment Scale

The third section of the study questionnaire utilized a modified version of the Dental School Learning Environment Survey (DSLES) to determine respondents' satisfaction with various aspects of the learning environment. The 55-item Genetic Counseling Training Learning Environment Scale (GCTLES) is comprised of seven

subscales: flexibility, student to student interaction, emotional climate, supportiveness, meaningful experience, organization, and breadth of interest. The survey uses a Likert scale of 1 to 4 corresponding to seldom, occasionally, fairly often, and very often, respectively. A participant has the option to score a 5 indicating "insufficient information." For purposes of this study, a score of 5 was considered to be a missing value and was not used in the calculation of subscale mean score. A higher score indicates a greater level of satisfication.

Results from the genetic counseling training learning environment scale. The total mean score for satisfaction with the learning environment for all participants was 3.30 out of 4.0. The average scores for each subscale amongst all participants are depicted in figure 7.

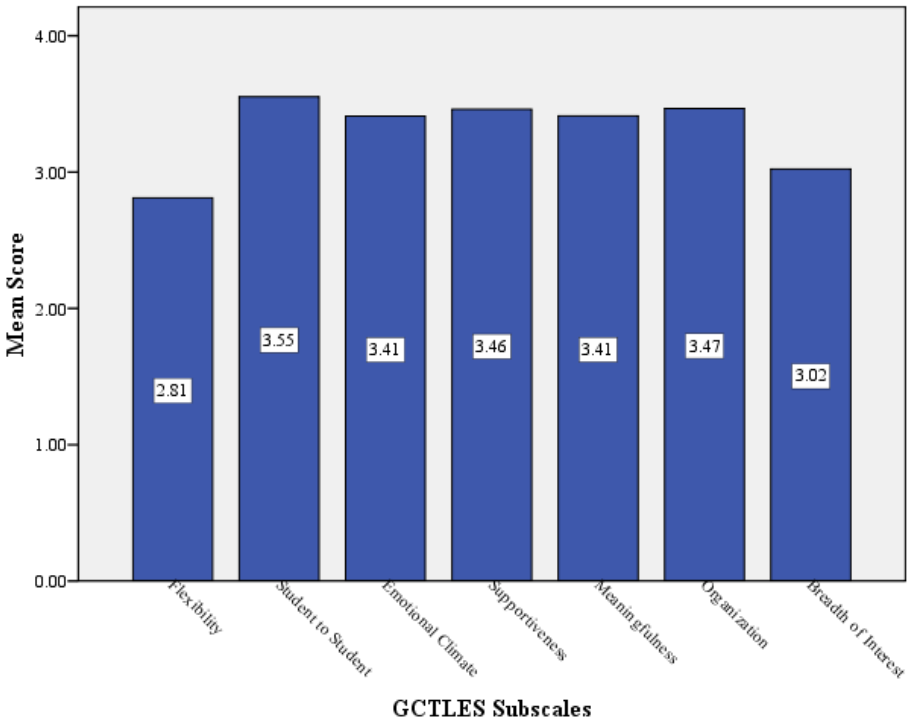


Figure 7. Average scores for each Genetic Counseling Training Learning Environment Subscale.

The highest scoring subscale, with a mean of 3.55, was student to student interaction, and the lowest scoring subscale was flexibility (students' ability to alter the program's learning environment), with a mean of 2.81 for the combined cohorts of first and second year trainees.

Year of study and GCTLES scores. An independent *t* -test was conducted to determine if there were differences between first- and second-year trainees in relation to each of the subscales. No statistically significant differences were found for the total satisfaction score for any of the subscales. Table 4 shows the results of this analysis.

Table 4

Comparison of Means for GCTLES Subscales Between First and Second Year Trainees

GCTLES Subscale	First Year Mean	Second Year Mean	*T*	*P*
Flexibility	2.83(.525)	2.79(.535)	0.66	0.51
Student to Student	3.53(.442)	3.53(.495)	0.75	0.45
Emotional Climate	3.44(.447)	3.38(.495)	1.12	0.27
Supportiveness	3.50(.491)	3.41(.496)	1.56	0.12
Meaningfulness	3.43(.366)	3.39(.411)	1.07	0.29
Organization	3.49(.401)	3.44(.490)	1.11	0.27
Breadth of Interest	3.06(.443)	2.98(.455)	1.43	0.16
Total Satisfaction	3.33(.334)	3.27(.365)	1.43	0.15

*Notes.*Degrees of freedom = 268.Standard Deviations appear in parentheses next to the means.

Learning Styles

Modes of learning and year of study. The last section of the survey was comprised of Kolb's Learning Style Inventory (LSI). Responses from the LSI generate four modes of learning that occur in a cyclical mannerand in which a learner needs to encounter in order for learning to be effective. These are concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). Multivariate analysis was conducted to determine if there was a difference in modes between trainees in different years of study. There was a significant effect of year of study on active experimentation learning mode, $F(4,262) = 1.67$, $p = 0.05$; Wilks' Lambda = .97; partial $\eta^2 = 0.25$. More second-year students were in the active experimentation part of the learning cycle compared to first-year students. Analysis of each dependent variable (mode) showed that there was no contribution of year of study on the other three modes of concrete experience, reflective observation, or abstract conceptualization, $F(1,265) = .31$, partial $\eta^2 = .001$; $F(1,265) = 3.00$, partial $\eta^2 = .011$; $F(1,265) = .20$, partial $\eta^2 = .001$; respectively.

Learning styles. These four modes were then used to determine learning styles which can be classified into four or nine styles. Four subjects did not complete the LSI properly and thus were excluded from analysis resulting in 267 respondents. Kolb provides calculations on how to classify into four or nine styles based on respondents' scores for AE, AC, CE, and RO. Data for both the four and nine style breakdowns are presented in tables 5 and 6 and figures 8 and 9 in the following sections.

Kolb's four learning styles.Historically, the Kolb Learning Style Inventory is used to create four learning styles: assimilator, accommodator, converger, or diverger.

When considering the four styles for this study population, the most commonly reported style was "assimilator" regardless of year of training. When specifically analyzing by year of training, the least common style for first year trainees was "accommodator" and least common learning style for second year students was "converger."

Table 5

Frequency of Four Kolb Learning Styles by Year of Study

Learning Style	First Year[a]		Second Year[b]	
	Frequency	Percent	Frequency	Percent
Accomodator	22	15.5	29	23.2
Diverger	41	28.9	29	23.2
Converger	30	21.1	25	20.0
Assimilator	49	34.5	42	33.6

Note. [a] n = 142. [b] n = 125

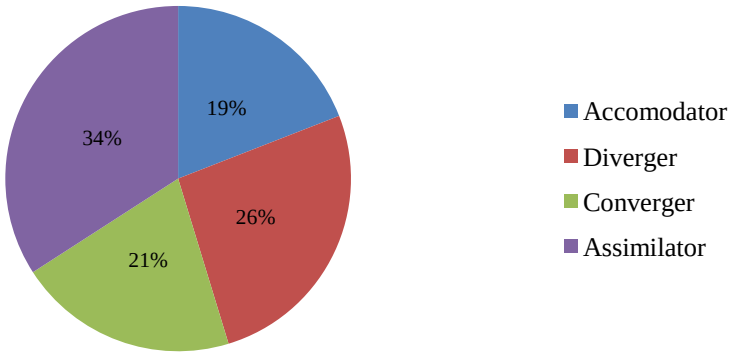


Figure 8. Overall Percentages of the Four Kolb Learning Styles.

Kolb's nine learning styles. Kolb and Kolb have expanded their interpretation of learning styles by classifying into nine styles rather than four (Kolb, & Kolb, 2005a). Thus, the results from the Learning Style Inventory were also broken down in to these

nine styles. For the nine styles, "imagining" was the most frequent style reported by first year trainees, and for second year students "initiating" was the most common learning style. The "deciding" learning style was the least frequent style for those within their first year of study whereas "balancing" was the least common for second year students.

Table 6

Frequency of Kolb's Nine Learning Styles by Year of Study

Learning Style	First Year[a]		Second Year[b]	
	Frequency	Percent	Frequency	Percent
Initiating	18	12.7	20	16.0
Experiencing	12	8.45	12	9.60
Imagining	28	19.7	19	15.2
Reflecting	26	18.3	12	9.60
Analyzing	22	15.5	16	12.8
Thinking	9	6.34	19	15.2
Deciding	5	3.52	9	7.20
Acting	14	9.86	10	8.00
Balancing	8	5.63	8	6.40

Note. [a] n = 142. [b] n = 125

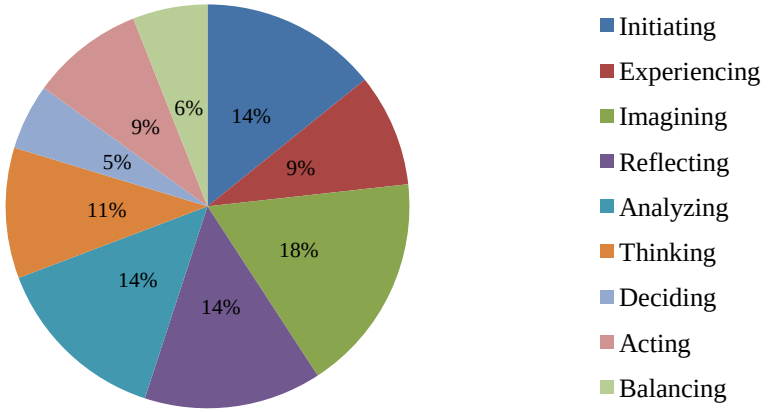


Figure 9. Overall Percentages of the Nine Kolb Learning Styles.

Year of study and learning styles.A chi-square analysis was carried out to determine whether there were significant differences between year of study and learning styles. This analysis was performed twice, once for the four Kolb learning styles and again for the nine Kolb learning styles. There was no relationship between year of study and the learning style for either the four or nine classifications, χ^2 (3, N = 267) = 2.94, p = .40 and χ^2 (8, N = 267) = 12.82, p = .14, respectively.

Furthermore, chi-square tests for each style were performed, and there were no statistically significant relationships between year of study and the four learning styles. However, when assessing for relationship between year of study and the nine learning styles, two styles demonstrated a significant relationship. The first was for the "reflecting" style as a greater number of first year trainees fell within this style compared to second year students, χ^2 (1, N = 267) = 4.13, p = .042, and the second was for the "thinking" style where more second year students had this learning style compared to first year students, χ^2 (1, N = 267) = 5.56, p = .018.

Structural Equation Modeling

The benefit of structural equation modeling (SEM) is to determine both direct and indirect relationships between variables. For this study, the statistical software package AMOS 21 was used to carry out the SEM. An important issue in SEM analysis is sample size, as SEM requires relatively large samples. In general, sample sizes greater than 200 are considered adequate; however, the analysis may require a larger sample size when several variables are being assessed in a complex model (Hox & Bechger, 1998; Kline, 2011). As mentioned earlier in this chapter, the *N* was 271 which should be sufficient for SEM; however, researchers have tried to determine the appropriate sample size as the number of parameters increases. Given the complexity of the initial model, this study's sample size may be too small to determine significant parametric estimates.

The original conceptual model is presented in figure 10 below.

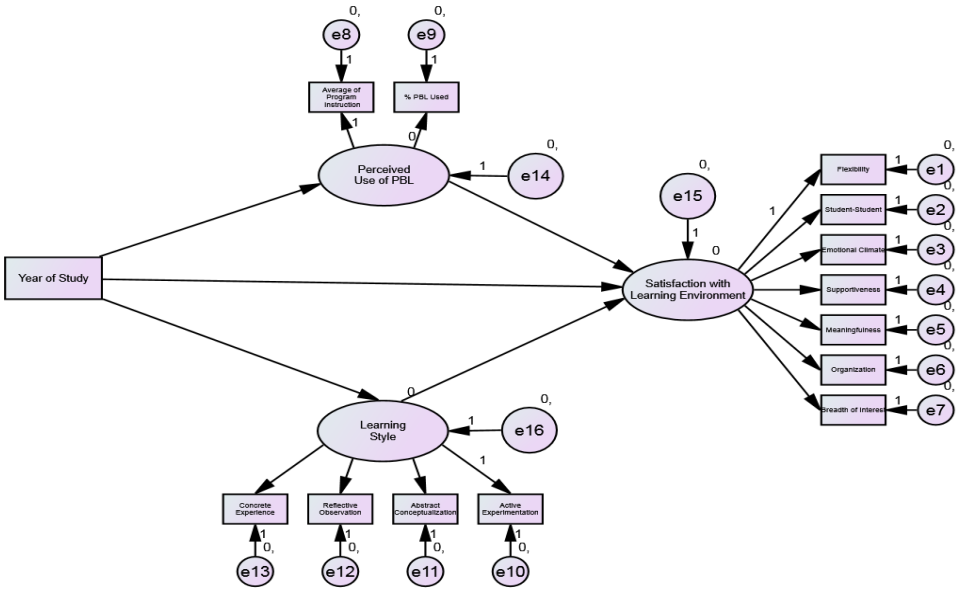


Figure 10. Conceptual Structural Equation Model.

Initial analyses of the data determined that the latent variable "Learning Style" did not correlate well with the modes from the Kolb Learning Style Inventory; therefore, this latent variable was deleted from the model. This outcome should have been expected given that the ipsative nature of the Kolb learning style scoring relies on mutual exclusivity and analyses that utilize correlations, such as factor analysis and SEM, cannot be performed in such circumstances (Mainemelis, Boyatzis, & Kolb, 2002). In addition, the percent of PBL used was also determined to be a variable that was not useful in the analysis and was also deleted from the model. Thus, the initial model for the starting point of the SEM is below in figure 11 with the parametric measures presented for standardized results.

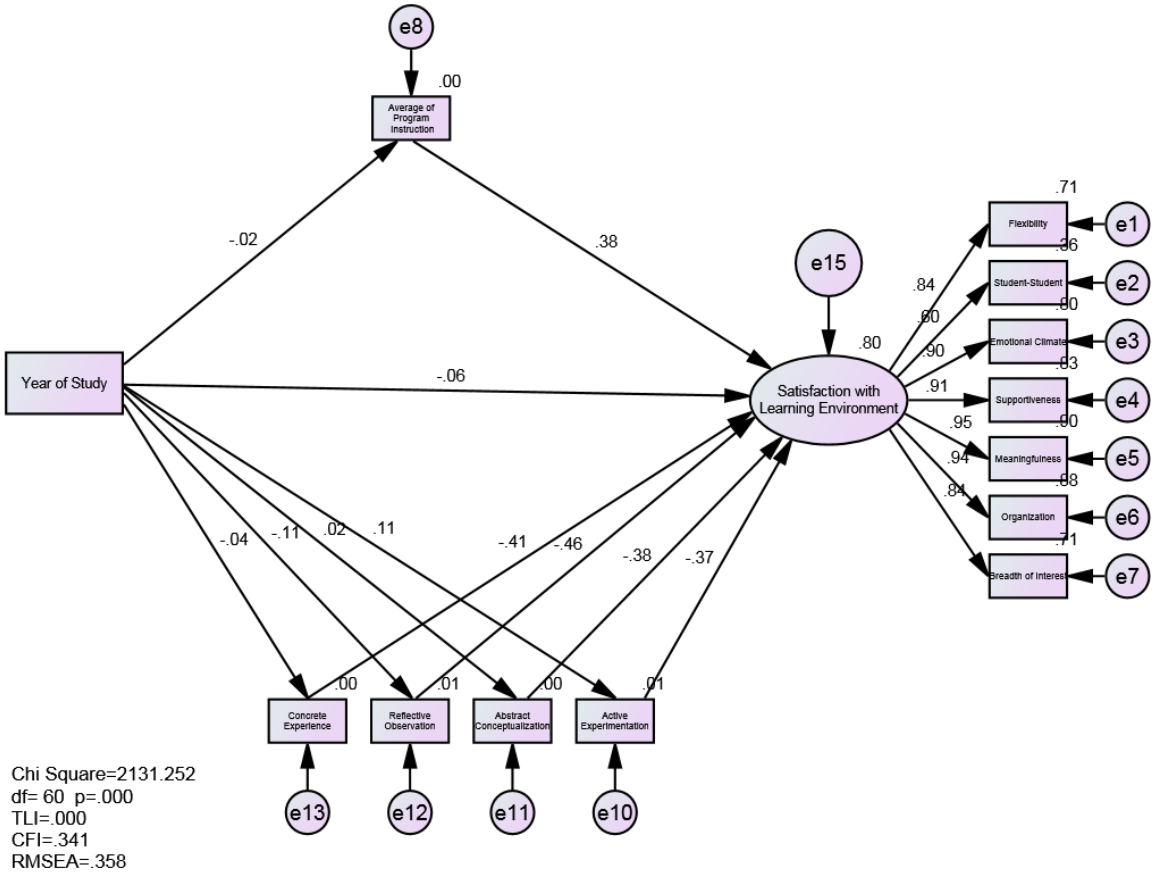


Figure 11. Initial Structural Equation Model (2a) Output

Initial structural equation model. The statistics for the initial model, as well as the data for the respecification models are presented below in table 7. When evaluating the statistics, a higher degree of goodness of fit is achieved when the chi-square value is low; there are non-significant *p* values; the Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI) are at least 0.90 but levels of greater than 0.95 are best; and lastly, the Root Mean Square Error of Approximation (RSMEA) should be low, at least less than 0.08 whereas levels of < 0.05 are best.

Table 7

Data from Initial Model Respecification

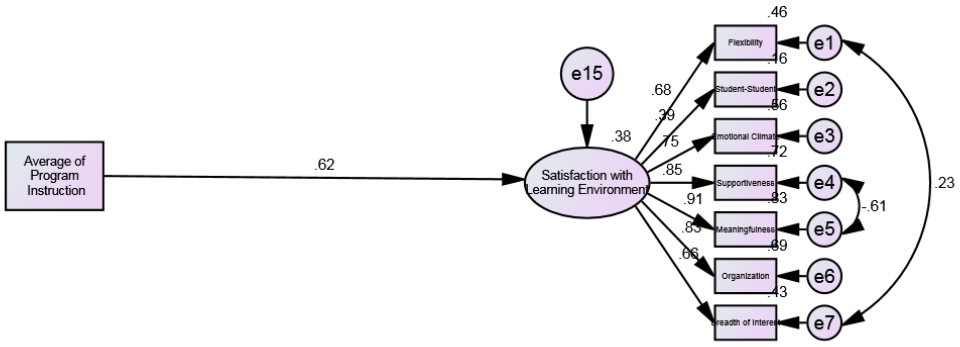
Model	χ^2	df	*P*	TLI	CFI	RMSEA
2a: Initial	2135.79	60	.000	.000	.341	.358
2b: Removed year of study to AC	2131.41	61	.000	.017	.341	.355
2c: Removed year of study to CE	2131.79	62	.000	.033	.341	.352
2d: Removed year of study to average of PBL	2131.90	63	.000	.049	.342	.349
2e: Removed year of study to satisfaction with learning environment	2135.77	64	.000	.063	.341	.346
2f: Removed year of study to RO	2138.98	65	.000	.076	.340	.344
2g: Removed year of study to AE	2142.48	66	.000	.089	.339	.341

Notes. df = degrees of freedom; *p* = level of significance; TLI = Tucker Lewis Index; CFI = Comparative Fit Index; RSMEA=root square mean error of approximation; AC = Abstract Conceptualization; CE = Concrete Experience; average of PBL = mean score of perceived use of practice-based learning techniques used in program; RO = Reflective Observation; AE = Active Experimentation

The initial model did not provide a good fit for the data and hypothesized model as demonstrated in table 7. None of the alterations made to this model achieved significant levels of significance on the aforementioned indices as demonstrated in table 7. Each modification was based on removing non-significant relationships in a step-wise manner beginning with removal of the most non-significant correlation and proceeding to the next most non-significant relationship and so forth.

In order to improve goodness of fit, various models were tested with different combinations of Kolb learning modes and perceived use of PBL. These models did not fit the data; therefore, the Kolb modes of learning were removed and the perceived use of PBL was the only predictor of satisfaction with the learning environment. A query was conducted in AMOS for modification indices to determine which relationships or covariances should be added that had been previously excluded from the model was conducted. These indices suggest alterations that will improve goodness of fit by lowering the chi-square value. It was found that two significant covariances involving the subscales of the Genetic Counseling Training Learning Environment Scale should be added into the model. The first was the negative correlation (r=-.61) between the supportiveness and meaningful experience subscales (model 3h), and the second involved a positive correlation (r=.23) between the flexibility and breadth of interest subscales (model 3i). Supportiveness is a reflection of how students perceive faculty concern and interest in the student, whereas meaningful experience relates to how relevant teaching material is made to the field of genetic counseling. A negative correlation between the two variables is a somewhat unexpected as one would expect that the perception of more supportive faculty would create a more meaningful and relevant learning experience for

students. The second correlation demonstrates a relationship between how much the faculty allow the students to alter the teaching milieu and how much encouragement students are given to explore activities internal and external to the training program. While the correlation was weak, this indicates that greater flexibility demonstrated by the faculty the more likely students will feel empowered to engage in activities outside the classroom such as time with friends or family. The resulting model, model 12, had the lowest chi-square value of all the respecifications run, as well as the highest levels of TLI and CFI. The RSMEA (.081) approached an acceptable level although it did slightly exceed .08 which is not ideal. The model shown in figure 12 below indicates that the average PBL score has a direct relationship on satisfaction with the learning environment, with 38% of the variance being related to the average PBL score. No other variables had a significant impact on satisfaction thus the resulting model is a much streamlined version of the initial model.



Chi Square=50.004
df= 18 p=.000
TLI=.944
CFI=.972
RMSEA=.081

Figure 12. Structural Equation Model 12.

Final model. Once an acceptable model was found indicating a significant relationship between perceived use of practice-based learning and satisfaction,

anothermodel was proposed. As suggested by Jöreskog (1993), when doing SEM analysis to begin with a large model, pare down to a small and well-fitting model and then build the model up again to achieve the final model. By removing year of study, this allowed the flexibility to include the Kolb learning styles as an exogenous variable. When deciding whether to use the four Kolb learning style classifications versus the nine style classifications for this final model, power of the typology was taken into account. Since more than a third of the nine learning style categories had frequencies less than 10% in the sample population, due to the parsing of several categories in a relatively small sample, this limited the power of this classification. For this reason, the four style typology was used in the final model. Learning style could be used in the model, rather than the modes of learning, as style is based on a scaled outcome of AC and CE and AE and RO. This solves the problem related to using only the Kolb learning modes of AC, CE, AE, and RO. In order to include the four learning styles, the styles were dummy coded so that the categorical variables of learning style could be used in the correlation analyses. The assimilator learning style was chosen as the reference variable as it was the most common style seen among the study population; therefore, the result for the other three learning styles are in relation to the assimilating style.

Figure 13 shows the final model, and table 8 reports the goodness of fit indices and related values for the model.

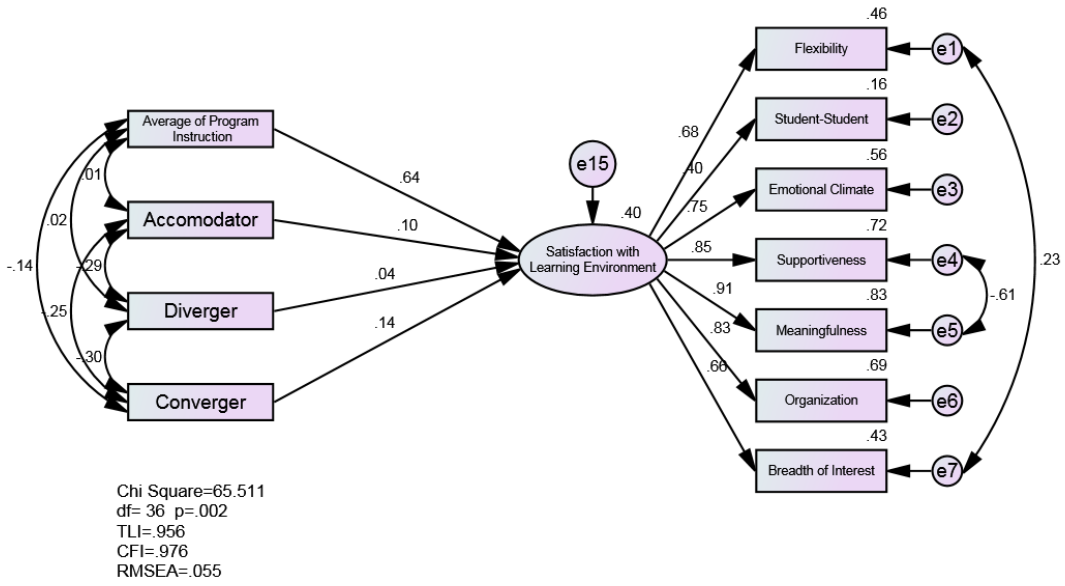


Figure 13. Final Structural Equation Model

Table 8 demonstrates this model has acceptable fit based on the TLI and CFI values and the RSMEA is < 0.08. Table 9 delineates the parametric estimates of this final model which indicate that the converger style when compared to the assimilator has a statistically significant impact on satisfaction with the learning environment. However, having a learning style of diverger or the accommodator style when compared to assimilator did not have statistically significant impact on satisfaction.

Table 8

Final Model Goodness of Fit Indices

Final Model	χ^2	df	*P*	TLI	CFI	RMSEA
	65.51	36	.002	.956	.976	.055

Table 9

Parametric Estimates of Final Model

Regression

Path	Unstandardized Beta	Standardized Beta	S.E.	*P*
Satisfaction ← Average PBL Score	.68	.64	.07	<.001
Satisfaction ← Accomodator	.09	.10	.05	.078
Satisfaction ← Diverger	.03	.04	.05	.452
Satisfaction ← Converger	.12	.14	.50	.016
Flexibility Subscale ← Satisfaction	1.0	.68	-	-
Student- Student Subscale ← Satisfaction	.52	.40	.08	<.001
Emotional Climate Subscale ← Satisfaction	.99	.75	.09	<.001
Supportiveness Subscale ← Satisfaction	1.2	.85	.10	<.001
Meaningful Experience Subscale ← Satisfaction	.99	.91	.08	<.001
Organization Subscale ← Satisfaction	.95	.83	.08	<.001
Breadth of Interest Subscale ← Satisfaction	.83	.66	.07	<.001

Covariance

Path	Covariance	Correlation	S.E.	*p*
Average PBL Score ↔ Diverger	.002	.016	.009	.802
Average PBL Score ↔ Converger	-.018	-.137	.008	.029
Accomodator ↔ Diverger	-.050	-.290	.011	<.001
Accomodator ↔ Converger	-.039	-.247	.010	<.001
Diverger ↔ Converger	-.054	-.304	.011	<.001
Average PBL Score ↔ Accomodator	.002	.015	.008	.811
e4 ↔ e5	-.025	-.609	.004	<.001
e1 ↔ e7	.030	.230	.009	<.001

Research Question and Hypotheses

This study set forth to answer five hypotheses that aim to answer the following research question: "Do trainees' learning style, year of study, and perceived use of practice-based learning have effects on satisfaction with the learning environment?" The following section will outline each hypothesis and the outcome based on analysis of the data.

Hypothesis 1.

The learning styles of genetic counseling trainees have a direct impact on the satisfaction with the learning environment.

Those participants who had a preference toward the converger learning style on the Kolb Learning Style Inventory in relation to assimilators tended to have higher levels of satisfaction with the learning environment as demonstrated by the SEM analysis. Although the final structural equation model showed a direct impact on satisfaction for this particular learning style, the standardized regression correlation was weak with a value of .14. This means that approximately two percent of the variation seen in satisfaction scores is accounted for by having a preference for the converger learning style in comparison to the assimilator learning style. The other learning styles, diverger or accommodator, did not show a significant difference in comparison to the assimilator learning style. Based on the findings the hypothesis is accepted but with a weak significance.

Hypothesis 2.

Perceived use of practice-based learning has a direct impact on satisfaction with the learning environment.

Perceived use of practice-based learning (PBL) was ascertained in two manners from the study survey. First, participants were asked to answer 14 questions that related to the teaching methods employed within their respective training programs. Thirteen of these questions specifically related to PBL teaching methods. A mean score was obtained for each respondent with higher numbers indicating a greater use of PBL instruction. The second way perceived use of PBL was assessed was for respondents to state the percentage of time spent on PBL teaching techniques. It was determined that this latter data point was not a strong and accurate measure of use of PBL compared to the mean score of PBL used in the classroom. Therefore, the percentage was dropped from the structural equation modeling and only the average score was used in modeling. The final structural equation model determined that the average PBL score did have a direct impact on satisfaction. The beta weight (or standardized regression coefficient) between average PBL score and satisfaction with the learning environment is .64, which means that 40% of the variance with satisfaction is due to the perceived use of the averaged PBL teaching techniques used. Based on this data, this hypothesis was accepted.

Hypothesis 3.

Genetic counseling trainees' year of study has a direct impact on learning styles.

Year of study was determined to not be a significant factor in having an impact on learning styles, and this variable was excluded from the structural equation modeling. However, chi square analyses found mixed results based on whether learning style was broken down into four or nine styles. When using the four Kolb learning styles, there were no statistically significant differences between first year and second year trainees.

However, when defining learning styles by the nine classifications, there was a statistically significant difference for two of the nine styles. The reflecting style was seen more often for first year students compared to second year trainees, and the thinking style was demonstrated more commonly in second year trainees compared to those in their first year of study. Overall, this hypothesis was not strongly supported by the data.

Hypothesis 4.

*Genetic counseling trainees' year of study has a direct impact on perceived use of practice-based learning***.**

Again, year of study was not a significant factor in the structural equation model, and a *t-test* did not identify any statistically significant differences between those in their first year of training compared to second year trainees with regard to perceived use of practice-based learning. Use of the fourteen teaching techniques inquired about in this study did not differ between the two cohorts of students; therefore, data analysis did not support this hypothesis.

Hypothesis 5.

Genetic counseling trainees' year of study has both a direct impact on the perceived use of practice-based learning and an indirect impact through learning style and perceived use of practice-based learning on satisfaction with the learning environment.

The overall assumptions that year of study influences perceived use of practice-based learning, learning style and satisfaction with the learning environment were not upheld by various analyses conducted for this study.

Summary of Results

The study was an attempt to determine factors that impact learning style and satisfaction with the learning environment. Results demonstrated that these variables were not influenced by whether participants were in their first or second year of training as speculated. Learning style was weakly associated with overall satisfaction with the learning environment with those with the converger learning style as compared to assimilator learners showed a significant difference with satisfaction.

The assessment of learning styles for the respondents indicated a third of the participants demonstrated a preference for the assimilator learning style when evaluated for the four historical Kolb learning styles. When the learning styles were analyzed for the more recent nine styles, imagining was slightly more frequent than the other styles; however, three additional styles, initiating, reflecting and analyzing, were also relatively frequent.

The most significant finding was that perceived use of practice-based learning had a direct impact on satisfaction with the learning environment. In addition, the majority of participants were satisfied with their learning environment, regardless of the factors that influence their level of satisfaction.

CHAPTER V

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This concluding chapter will recapitulate the purpose of this study and review the research question posed for this study, summarize the findings of this study, delineate conclusions determined from the study, and consider limitations, recommendations for future research on the topics presented herein, and implications for those involved in the training of genetic counseling graduate students.

Summary of the Study

The purpose of this study was to explore the factors that influence student satisfaction with the learning environment within a unique professional field. Little research has been conducted within the field of genetic counseling as it relates to the education and training of these allied health professionals. Formal training of these individuals has occurred for the past 40 years; however, there has not been much research carried out within the two-year master-level graduate school training programs. There were several goals of this study: to describe the learning styles of genetic counseling trainees, to assess the perceived level of practice-based learning (PBL) used within the training programs, and to evaluate student satisfaction with the learning environment. In addition to each of these individual goals, structural equation modeling was employed to

determine which variables had a direct and/or indirect impact on student satisfaction with the learning environment. Variables that were analyzed included year of study, i.e. a first or second year student, learning style, perceived use of PBL, and their impact on student satisfaction.

The following is the study's research question with corresponding hypotheses:Do trainees' learning style, year of study, and perceived use of practice-based learning have effects on satisfaction with the learning environment?

a. *Hypothesis 1:* The learning styles of genetic counseling trainees have a direct impact on the satisfaction with the learning environment.

b. *Hypothesis 2:* Perceived use of practice-based learning has a direct impact on satisfaction with the learning environment.

c. *Hypothesis 3:* Genetic counseling trainees' year of study has a direct impact on learning styles.

d. *Hypothesis 4:* Genetic counseling trainees' year of study has a direct impact on perceived use of practice-based learning.

e. *Hypothesis 5:*Genetic counseling trainees' year of study has both a direct impact and an indirect impact through learning style and perceived use of practice-based learning on satisfaction with the learning environment.

There has been extensive research conducted into the training and education of professional fields at the graduate level; however, there have been few studies conducted within the field of genetic counseling which is a relatively new profession compared to other health care professions (Curtis, Indyk, & Taylor, 2001; Enarson & Cariago-Lo, 2001; Susarla, Medina-Martinez, Howell, & Karimbux, 2003; van den Hurk, Wolfhagen,

Dolmans, & van der Vleuten, 1999). In an attempt to bridge this gap, this study was conducted to explore various aspects of the education of genetic counseling students who are enrolled in master-level training programs. The research that has been conducted in this field in relation to education focuses on various aspects of how to handle patient care issues, such as cultural competency or how to counsel for a specific indication (Stein, Fine, Pergament, 1994; Wang, 1998; Weil &Mittman, 1993). Much of the other research has pertained to clinical supervision, which was not a focus of this current research. There are no studies which have described the learning styles of genetic counseling trainees, the teaching techniques used within the programs and satisfaction with training.

An assessment of learning styles within a professional group can be advantageous in order to incorporate teaching strategies that may benefit certain styles. Being cognizant of one's learning style can enhance one's learning by using strategies that can increase knowledge gains (Pungent, Wasan, Moffett, 2003). Thus, if there is a learning style exhibited by the majority of genetic counseling trainees, training programs may wish to consider employing certain teaching modalities to augment learning. In addition, it is possible that satisfaction is influenced by a predominant learning style; therefore, determining this relationship can allow administrators involved in the development and implementation of learning to modify their programs accordingly.

Many of the genetic counseling training programs are housed within medical schools, which are now required to incorporate practice-based or problem-based learning (PBL) into their curriculum. Several studies have shown that PBL may be more advantageous to use with more advanced students as first-year trainees may benefit from more content driven teaching (Doig & Werner, 2000; van den Hurk, Wolfhagen,

Dolmans, & van der Vleuten, 1999). It has also been shown that utilizing PBL techniques leads to favorable outcomes such as enhanced learning, increased student satisfaction, and improved levels of retention in the profession following graduation (Curtis et al., 2001; Shenouda et al., 2003; Susarla, et al. 2003; Thomas et al., 2005; Whitfield et al., 2002). However, no analysis has been performed to determine how widespread the use of PBL is within the genetic counseling training programs.

Student satisfaction is an important factor to evaluate as prior research demonstrates evidence of a positive correlation with professional attitude, commitment to one's profession, and remaining in the field (Stith, Butterfield, Strube, Deusinger & Gillespie, 1988; Ziaee, Ahmadinejad, &Morravedji, 2004). Satisfaction with one's training has been shown to be increased when a student's education is made relevant and is contextual, which is a key concept in PBL (Emmons, Sells, & Eiff, 2002; Henzi et al, 2005). Thus, it stands to reason that there would be a positive correlation between use of PBL within a program and student satisfaction with the program. While student satisfaction can be assessed in several ways, one manner is to evaluate satisfaction with the learning environment; this includes the student's perceptions of both internal and external factors that impact learning.

In order to answer the research question, participants were asked to complete a survey that was comprised of several sections, each addressing an aspect of the study. The first section of the survey captured demographic information and educational background: past educational experience, whether they were the first in their family to attain an undergraduate or graduate degree, whether they were making a career change, and expectation of continuing with training. In order to assess general levels of

satisfaction, respondents were asked to rather their overall satisfaction with their life at the moment. The second section of the questionnaire was aimed at assessing teaching techniques utilized within the respective graduate training programs to determine the amount of PBL instruction used versus didactic teaching. Satisfaction with the learning environment was evaluated in the third section of the survey by the Genetic Counseling Training Learning Environment Scale (GCTLES). This scale was adapted from the Dental Learning Environment Survey and assesses satisfaction from the viewpoint of seven subscales. Lastly, learning style was determined in the fourth section of the survey, utilizing the Kolb Learning Style Inventory.

Participants for this study were recruited from the 32 genetic counseling training programs across North America that were accredited by the American Board of Genetic Counseling at the time of this study. Surveys were sent to the program directors of each of the programs who subsequently distributed the surveys to their students. At the time of this study, there were 468 students enrolled in these training programs, and a total of 271 individuals mailed back a completed questionnaire, for a response rate of approximately 58%. This sample size is sufficient for structural equation modeling as it is generally acceptable to have a sample size of at least 200 to conduct such analysis.

Findings

This study assessed several factors of those enrolled in genetic counseling training programs. The first was the teaching techniques employed within the programs, with a focus on the amount of practice-based learning (PBL) utilized in the classroom. The majority of respondents reported that varied PBL teaching techniques were used within their programs, with open discussion and brainstorming being the modalities that rated

the highest. Techniques that were not heavily used were self-directed learning, field trips, journaling, and oral examinations. Teaching methods did not vary significantly between first and second year of study. An overwhelming majority of the study's participants were satisfied with the teaching modalities used within their programs, with only 6% of the respondents being dissatisfied.

Satisfaction with the overall learning environment was evaluated by having respondents complete the Genetic Counseling Training Learning Environment Scale (GCTLES), which was created specifically for this study. This scale was adapted from the Dental School Learning Environment Survey to accommodate genetic counseling students. The GCTLES has seven subscales associated with it that assess satisfaction in several areas: flexibility, student-to-student interactions, meaningful experience, supportiveness, organization, breadth of interest, and emotional climate. For all participants, the highest ranking subscale was student-to-student interaction which relates to how well students get along both academically and socially. The majority of the other scales were scored favorably by the participants; however, the lowest ranked subscale was flexibility which relates to how much students are able to adjust the training program'satmosphere. There were no statistically significant differences found with the subscales between participants who were in their first or second year of training.

Students' learning styles were evaluated through the Kolb Learning Style Inventory (LSI). The LSI is reported by determining scores for the four modes of learning as deemed by the Kolb learning cycle – active experimentation (AE), abstract conceptualization (AC), reflective observation (RO), and concrete experience (CE). Of the four modes, there was a statistically significant difference between year of study and

the AE mode, only. No other differences were found between year of study and the other three modes.

By plotting the four modes on two gradients between AE and RO and AC and CE, determination of learning style according to Kolb is achieved. As the Kolbs have expanded the interpretation of their learning style model, learning styles can be broken down into either four styles or nine styles as determined by one's answers to the LSI. When evaluating for four styles, 34% of the overall study population were classified as assimilators; however, there were no statistically significant differences found between respondents in the two cohorts by year in training. Categorizing by the nine learning styles revealed that the most common style was the imagining learning style, which accounted for 18% of the study population. Comparisons between first and second year students with the nine styles indicated that two styles were statistically significant, reflecting and thinking. More first year students compared to second year students had a reflecting learning style, whereas the thinking learning style was seen more often in second year students compared to first year students.

Finally, a structural equation model was utilized to determine indirect and direct relationships with the variables of year of study, learning style, perceived use of practice-based learning, and satisfaction with the learning environment. Overall the initial proposed model was ill-fitting as year of study had no relationship on any of the other variables. The only significant finding from the initial model was perceived use of PBL did have a significant impact on satisfaction with the learning environment, accounting for 38% of the variance seen with satisfaction scores.

A revised structural equation model was performed by eliminating year of study and using exogenous variables of perceived use of PBL and three learning styles: diverger, converger, and accommodator, as compared to assimilator. In addition to perceived use of PBL demonstrating a significant impact on satisfaction, having a converging learning style led to more satisfaction than those with an assimilating style. While statistically significant, the contribution of this learning style to satisfaction was low, accounting for only ~2% of the variation seen in satisfaction scores. Being a diverger or an accommodator as compared to assimilator did not have a significant impact on satisfaction. This final model revealed good fit on several indices including a strong CFI and TLI and a relatively low RSMEA indicating that satisfaction is directly impacted by perceived use of practice-based learning and at least one Kolb learning style, converger.

Conclusions for Genetic Counseling Education

There are several conclusions that can be gleaned from the results from this current study. These will be addressed in the following manner: those related to teaching techniques used within the genetic counseling training programs, especially in relation to practice-based learning (PBL); learning styles; and lastly, satisfaction with the learning environment.

With regard to teaching techniques used within the genetic counseling training programs, the respondents reported that many of the programs utilized PBL teaching techniques. Although the respondents indicated that two-thirds of the teaching methods used in their programs were didactic in nature, one-third of the teaching techniques were PBL-based. Of the PBL teaching practices, the programs use a variety of PBL teaching

techniques to enhance the educational setting. The overwhelming majority of the students reported favorable ratings of the teaching modalities used within the programs, regardless of year of study. This indicates that first-year students as well as second-year students thought that the use of PBL techniques was not a hindrance to their learning. This is somewhat contrary to previous studies that evaluated the effectiveness of PBL for first year students. For example, Brandt, Clements and Piascik (1998) reported that pharmacology faculty felt that a program that was strong in PBL for first year trainees would not be successful. It was believed that students early on in their training would not be able to apply the requisite information for PBL as they would not have the proper context or be able to process patient-related problems. Similarly, van den Hurk, Wolfhagen, Dolmans, and van der Vleuten (1999) questioned whether PBL would be useful for first year medical students in the Netherlands as these students rely on content rather than self-directed learning. A third study by Doig and Werner (2000) hadcomparable findings as presented in the discussion of their study. The authors state it is beneficial for their students, who are enrolled in medical school, to have an initial year of a content-laden curriculum which is followed by a more heavily weighted PBL curriculum in subsequent years of training. This allows acquisition of knowledge to be built upon basic concepts that are introduced in the first year of study and elaborated upon later in training through PBL.

The findings from this current study are contrary to all of the above findings but are consistent with other aspects of the Brandt, Clements, and Piascik (1998) study. While these authors found that faculty were skeptical of students' ability to handle PBL in their first year, they also found that first year students did like the relevance PBL

brings to the classroom. Although this current study did not specifically ask about the contextual aspect to PBL and whether this was a satisfier to the respondents of this current study, the results of this study reveal that trainees within genetic counseling programs appreciate and are satisfied with PBL techniques. Results of this study indicated that the amount of PBL teaching modalities used do not differ by year of study, as there were no reported significant differences between the two years. This indicates first year students received the relatively same amount of PBL as second year students and could handle the amount of PBL taught.

Perhaps students within the genetic counseling training programs like the PBL approach since the programs are relatively small compared to other professional groups. Smaller class size can more easily lend itself to many of the teaching strategies used for PBL, such as small group exercises, brainstorming, and open discussion. In addition, while there is a great learning curve to acquiring the amount of new information presented upon entering genetic counseling training programs, providing a realistic context may allow a greater degree of integration of the information. Of importance, the results from this study also indicate that learners with a variety of learning styles are satisfied with varied teaching techniques, including PBL. This is consistent with the data presented from Pungente, Wasan, and Moffett (2003) which showed that all types of learners as rated by the Kolb Learning Style Inventory favored PBL practices.

The learning styles represented by this study's participants are quite varied. No one predominating style emerged from the assessment of learning styles through the use of the Kolb Learning Style Inventory (LSI). The breakdown of styles was nearly equal for the four-style classification with assimilating, diverging, converging, and

accommodating accounting for 34%, 26%, 21%, and 19% of the study sample, respectively. This result indicates that genetic counseling trainees are not homogenous when it comes to learning styles, as evaluated by the Kolb LSI. Varied learning styles, as determined by the Kolb LSI, have also been demonstrated in studies that assessed other health care professionals' learning styles.

This current study's finding of multiple learning styles being representedis similar to reports from other professional groups in which varied learning styles are demonstrated within a profession.For those professions that were evaluated by more than one study, only the learning styles of the surgical residents and physical therapists were replicated (Contessa, J., Ciardiello, K., & Perlman, S. (2005; Hauer, Straub, & Wolf, 2005; Katz & Heimann, 1991; Mammen et al., 2007). For other professions, such as nursing, occupational therapists, and social workers, varied learning styles were identified when these groups were surveyed more than once (Baker, Pesut, McDaniel, & Fisher, 2007;French, Cosgriff, & Brown, 2007; Hauer, Straub, & Wolf, 2005; Katz & Heimann, 1991; Stutsky, 1995; Suliman, 2006). These studies, including this current study demonstrate that a specific learning style cannot be generalized to a particular professional group.

The array of learning styles represented in the genetic counseling trainees could be explained simply by individuality but could also be due to the varied aspects and skills required of genetic counselors. According to previous studies by Kolb and others, people in the sciences and information technologies tend to be assimilators (Hauer, Straub, & Wolf, 2005; Kolb, & Kolb, 2005b). Kolb states assimilators "are best at understanding a wide range of information and putting it into concise, logical form" (Kolb & Kolb,

2005b, p. 5). One of the major roles ofa genetic counselor is to take complicated information and pare it down so that clients can comprehend the information, which iscompatible with the assimilator learning style.Although Kolb describes that those with a diverger style tend to be interested in the arts, many of the attributes given to those with this learning style can be seen as beneficial to genetic counselors (Kolb & Kolb, 2005b). For example, divergers tend to gather data and they are able to look at issues from differing perspectives; both skills are employed by genetic counselors on a daily basis. Convergerssolve problems by taking theories or ideas and making sense out of them and are often people who work in technology (Kolb & Kolb, 2005b). Again, these characteristics can be seen in the work required of genetic counselors and understanding technology is a major component of the field of genetics. Lastly, the accommodating learning style is exemplified by individuals who often challenge themselves by getting involved in new situations and completing plans. Additionally, these people tend to be action-driven and often work in sales or marketing (Kolb & Kolb, 2005b).

When considering the above attributes for each learning style, it is possible to discern the traits that would be important to genetic counselors. Since the profession is a blend of science and psychology and requires practicing individuals to be able to analyze data as well as interact with people, it would stand to reason that the individuals in the profession would have different viewpoints of learning. Attributes of the assimilator, diverger, and converger can be seen in the work required of genetic counselors which may explain why 81% of the study population was evaluated as having one of these styles. The least frequently reported style, accommodator, has characteristics that may not be as important to genetic counselors when it comes to patient care. However, as

more genetic counselors are being employed by commercial laboratories they are forging new territories and are taking on more of a sales role, which is consistent with the accommodator style. It would be interesting to determine if those genetic counselors who gravitate to these types of sales positions tend to favor the accommodating learning style.

None of the aforementioned studies used the nine style categorization, as this typology is relatively new. However, when looking at the breakdown for this study population, a slight preference, but one that was not statistically significant, was seen for the imagining style. Eighteen percent of the respondents in this study were ranked as having an imagining style, which replaces the diverging style in this nine-style typology. Individuals with this style prefer to sit back and observe, are able to view problems from various perspectives and consider several opinions, are sensitive to other's feelings, and prefer group settings that are open and offer brainstorming opportunity (Kolb & Kolb, 2005a). This last aspect is important as many of the respondents reported that a high use of brainstorming occurred in the classroom, which would be congruent with those with the imagining style of learning. In addition, it is helpful for genetic counselors to have this type of learning when it comes to the element of looking at issues from a variety of perspectives as this skill is needed when counseling patients. First, it is critical that genetic counselors help the families they are working with evaluate their situation from varied aspects, such as medical, social, emotional, and financial. Second, what is right for the genetic counselor may not be right for the individual or family with whom they are working; as such, genetic counselors must be able to view sensitive issues from perspectives other than their own and provide unbiased counseling.

Among the classification of nine learning styles, there were three that were relatively frequently reported by this sample (14% each): initiating, analyzing, and reflecting. Thus, some attention should be paid to the characteristics of these styles. First, those with the initiating style generally prefer hands-on experience, are willing to try out new experiences, can think on their feet, and are risk takers and initiate new projects (Kolb & Kolb, 2005a; Kolb & Kolb, 2011). Clearly the hands-on experience is helpful for some of PBL teaching techniques, such as field trips and role play; however, it is most beneficial during the clinical internship portion of genetic counseling training. With regard to the risk-taker aspect, many genetic counselors need to forge new employment positions as jobs are often limited. Hence, several genetic counselors have created their position from scratch with developing business plans and having to justify their employment.

Individuals with the analyzer style tend to integrate ideas by reflection; are less interested in people and prefer concepts and abstract ideas; weigh each possible outcome and consequence before making decisions; prefer learning by lectures, models, and reading but also having time to think about ideas; and prefer working alone (Kolb & Kolb, 2005a; Kolb & Kolb, 2011). Interestingly these individuals require less personal interaction when learning which is not congruent with those in the genetic counseling field. Many prospective students and genetic counselors began their careers working in laboratories but move toward genetic counseling because they miss interacting with people. Thus, it is a bit surprising that a fair amount of respondents in this study fall into this learning style; however, it should be noted that this is only one facet of this learning style. Other aspects of this style are helpful for genetic counselors such as the desire to

reflect, to read, and to think about ideas. Often genetic counselors are required to cull the literature for information about medical conditions or research conducted on particular genes, in order to gather the appropriate information to perform their job. In addition, many patients are an enigma to the medical community due to the multiple symptoms they possess, and there is often a need to think about the varied medical issues a person has in order to provide a unifying diagnosis. This learning style lends itself to researching, thinking, and coming up with diagnoses.

Lastly, those with the reflecting learning style prefer identifying problems and can come up with various ideas; learn by observing and reflecting; like to assist in building consensus; prefer learning situations that are full of dialogue but can also learn by lectures, reading, independent projects; and gather information and can collate into meaningful outcomes (Kolb & Kolb, 2005a; Kolb & Kolb, 2011). It is clear from the description above regarding the tasks that genetic counselors perform with regard to trying to ascertain diagnoses, that many of the same skills seen in the analyzing style are echoed with the reflecting style. The gathering of information or identifying problems and coming up with conclusions is a common occurrence for genetic counselors. With regard to teaching techniques, these individuals like reflecting and dialogue which was reported by many of the respondents of this study being used in their programs.

It was speculated that there would be a difference in learning styles between first- and second-year trainees given those in the first year of training could have had a more immature learning style according to the Kolb learning cycle (Kolb & Kolb, 2009). According to Kolb (2009), early in the cycle, learners are more based in concrete experience (CE), then progress to reflective observation (RO), next to abstract

conceptualization (AC), and end with active experimentation (AE). Therefore, it was hypothesized that first-year trainees would fall more into the diverger category as these learners have dominant abilities in the CE and RO. However, there was not a statistically significant difference found between students in the two years of their training. Interestingly, as stated earlier, the assimilating category was accounted for in slightly more individuals compared to the other styles, and this style would be the second phase in Kolb's learning cycle, which has individuals' abilities falling between the RO and AC modes. It was thought that second year students would have a learning style that was further along the learning cycle, which was not the case. The accommodating learning style is the most advanced phase of the learning cycle, and the smallest proportion of all participants fell into this category.

For the nine styles, the most common style reported was imagining, the replacement term for the historical diverger style. Hence, it is interesting that when the styles are classified further, this style, which is more grounded in concrete experience, was preferred by slightly more respondents. Of the next three most common styles, two of the three (reflecting and analyzing) are also in the earlier part of the cycle. The third style, initiating, which replaced the accommodating style, does fall into the last phase of the cycle and is grounded in acting and experiencing. Therefore, only a small subset of the study's sample has a more advanced learning style, and it was speculated more second year students would be in this phase of the learning cycle. However, as this was not a longitudinal study, it cannot be determined from this study whether trainees' learning styles change over time, and individuals may proceed through the learning cycle in their own timeframe and become more mature with time. In addition, while it is

worthy to assess where on the learning cycle genetic trainees fall, due to the range of styles reported, and that not one predominant style was reported by the study group, it is not possible to label these trainees into one or two specific styles. However, of more importance, position in the learning cycle, as demonstrated by learning style, did not significantly impact satisfaction.

With regard to satisfaction with teaching techniques, it is clear from the aforementioned descriptions of learning styles, there are certain teaching methods that would be preferred for each type of learner. Because of this, it is important that training programs incorporate varied techniques to satisfy all types of learners. From this study's data, the programs do generally employ a variety of techniques, which means that learners with varied styles can find something they like with respect to the teaching that is occurring in the classroom of genetic counseling training programs. Whether it is didactic or practice-based, there should be a blend of teaching modalities to provide a satisfying learning experience as demonstrated by this study and others (Stith et al, 1988).

Satisfaction with teaching methods is only one element of satisfaction, which is why the use of a more global assessment of the learning environment is helpful. The Genetic Counseling Training Learning Environment Scale (GCTLES) was created for specific use with this study. This study population was very satisfied overall with the learning environment from all aspects, as demonstrated by the average score of 3.30 out of 4.0 for all participants. There were no differences in student satisfaction level between first- and second- year of training. This is interesting since it would stand to reason that the second year of study is much more stressful given the nature of work that is required at that time. Students are immersed in several pivotal projects toward the end of their

training, such as the completion of theses or capstone projects, final examinations and/or comprehensive examinations, and applying for jobs. Of note, this survey was distributed in the last semester for the second year students, the time when these projects are due. Given the higher demands on students at this time in their training, a higher level of stress would be expected that could negatively impact satisfaction; however, students' responses do not indicate this.

The highest scoring subscale for the learning environment was student-to-student interaction, which relates to how well the students engage with each other both academically and socially. Perhaps the relatively small sizes of the genetic counseling training programs lend themselves naturally to this interpersonal engagement. Unlike other studies, the organization subscale had the second highest score for the genetic counseling trainees (Lancaster et al., 1997). Organization deals with how coherent the information presented in class compares to the curriculum or how well the concepts flow from week to week. While genetic counseling trainees were satisfied with the level of organization in their respective programs, medical students in a strictly PBL-based curriculum found organization to be a problem (Lancaster et al., 1997). It is possible that the genetic counselors did not find organization to be lacking because none of the programs' curricula were solely PBL-based and all incorporated didactic lessons as well.

Another discrepancy between this current study and one study conducted in dental schools is that the latter found that first year dental students perceived a low emotional climate and that dental students in their third year did not feel supported by faculty as demonstrated by low supportiveness scores (Henzi et al., 2004). Emotional climate relates to how the students' experiences affect their perception of the education; for

example, one's anxiety could hinder one's performance. The genetic counseling trainees had a relatively high emotional climate score indicating that this is not an overarching concern for these students. Additionally, the genetic counseling students ranked the supportiveness subscale high as well, which indicates that these trainees feel supported by the faculty involved in their programs. It is unclear why there would be differences on these elements between dental students and genetic counseling students perhaps the smaller size of genetic counseling programs is one explanation. Regardless, it is encouraging to see that these are not aspects that are perceived to be lacking in the genetic counseling training programs.

When considering overall satisfaction within the learning environment, this study has similar findings to those seen in other studies with regard to PBL. The use of PBL has been shown to be positively correlated to satisfaction in medical schools and other health care professional training programs (Curtis, Indyk, & Taylor, 2001; Thomas et al., 2005). This current study adds to the literature surrounding the use of PBL in a previously unstudied population, genetic counseling students. In this current study, perceived use of PBL accounted for 40% of satisfaction with the learning environment, which is not trivial. In addition, covariances were noted between supportiveness and meaningful experience and between flexibility and breadth of interest. The former was a negative correlation, which seems to be incongruent as it would be expected that supportive faculty would be more invested in the students' education and would likely wish to make the learning experience meaningful and relevant. The latter was a positive correlation, which could possibly be explained if the students have the opportunity to alter the learning environment, as measured by the flexibility subscale, and the faculty

may be more willing to incorporate different activities into the coursework which is an aspect of breadth of interest. However, breadth of interest is also a measurement of how much encouragement the students receive for pursuing activities outside the classroom and this aspect was not measured in this study. Therefore, further speculation into the causal effects of these relationships cannot be elaborated upon.

When assessing learning style and satisfaction, those with a converging learning style demonstrated more satisfaction with the learning environment than assimilators. While the contribution to satisfaction was weak if one has the converging style, there was still a statistically significant difference compared to divergers and accommodators. No studies have previously compared learning styles and satisfaction with the learning environment. It is unclear why this relationship would exist, i.e. what underlying characteristics would cause a greater level of satisfaction for convergers compared to those with other learning styles.

The main findings from this study are that, overall, students within the genetic counseling training programs are satisfied with the mixed teaching methods used within their respective programs. Year of study did not have an impact on perceived use of PBL, learning styles in general, and satisfaction with the learning environment. Overall, learning style did not play a major role in satisfaction scores. Increased use of PBL did have a positive impact on student satisfaction as did having a converger learning style; however, the former variable was the most significant determinant of satisfaction.

Limitations of the Research

As with any research, there are always limitations to the study, and this current study is not without exception. Some have criticized Kolb's Learning Style Inventory

and subsequent learning styles, positing that these are not true reflections of one's learning style in that replication of one's learning style is often not achieved upon re-testing (Coffield, Moseley, Hall & Eccelstone, 2004: Pashler, McDaniel, Rohrer & Bjork, 2009). In addition, it has been reported to be beneficial to assess learning styles by more than one method; however, that would have been impractical for this study (Hawk & Shaw, 2007). Therefore, one limitation of this study is the identification of learning styles based solely on Kolb's Learning Style Inventory.

Assessment of the use of practice-based learning (PBL) in programs was done subjectively by self-report and asking the participants to recall the teaching techniques used within their programs. Since this data was captured retrospectively, it is possible that recall bias influenced how students answered this portion of the survey. While the goal of asking about the percentage of PBL versus didactic methods used in the respective programs was intended to be an internal validation of the fourteen questions that assessed use of PBL techniques, the reported percentages failed to provide such validation and proved to be a weak indicator of use of PBL within the classroom. Lastly, when considering the program instruction of the survey, participants were asked if they were satisfied with the teaching modalities used within their programs, but they were not asked if they would have changed any aspect of their training. Posing this question may have provided further insight into students' likes and dislikes and could have shed light on areas for improvement in relation to training.

While satisfaction was a major outcome variable of this study, one could question whether satisfaction is the most useful measurement. As studies have shown that satisfaction is an important factor for professional aspects post-graduation this may not

translate into effectiveness of teaching when considering the relationship with the use of PBL (Stith, Butterfield, Strube, Deusinger & Gillespie, 1988; Ziaee, Ahmadinejad, &Morravedji, 2004). Perhaps measuring self-efficacy or comparing an objective measure, such as examination scores, would be more useful, especially in determining the effectiveness of teaching methods.

Some limitations are out of the researcher's control and simply reflect the nature of the genetic counseling field and training of these individuals. First, the population is extremely homogeneous demographically and thus, the findings may be impacted. Second, since the training programs are only two years in duration, there may not be enough temporal difference between the first and second year of training to demonstrate differences in these two groups. Perhaps if training programs were lengthier, more significant differences would have been observed when comparing the two groups by year of study. Third, due to the small size of many of the training programs, analysis by program could not be undertaken which, if possible, could have provided additional information regarding the teaching practices utilized within the various programs.

When considering the statistical model used for this study, structural equation modeling (SEM) is sensitive to sample size, in that larger sample sizes allow for stronger estimates. While the sample size for this study was greater than 200, which is considered adequate for SEM, the complexity of the model may have benefited from a larger sample size. Although the ~58% response rate for this study was quite notable, an even greater response rate from the 468 potential respondents could have improved the outcomes of this research.

Lastly, the ipsative nature of the Kolb learning modes does not lend itself to SEM given the innate negative correlations that occur with this type of scoring and impedes analyses that utilize correlations such as factor analysis and SEM (Mainemelis, Boyatzis, & Kolb, 2002). Thus, using Kolb's modes of learning in the initial SEM analysis was problematic and needed to be replaced with the learning styles which are categorical variables based on scaled values. Therefore, another type of learning style assessment may have been a better choice when using SEM analysis. Although these are limitations with the current research study, they also provide opportunities for future research.

Recommendations for Future Research

As stated above, this research could be repeated using other assessments of learning style, such as the VARK inventory or others, to determine if this type of evaluation demonstrates significance with satisfaction with the learning environment. A learning style that is not based on forced answers like the Kolb model would be preferred if using SEM. In addition, satisfaction is only one outcome that could be measured as a result of teaching methods used within training programs. For example, it may be interesting to evaluate factors such as self-efficacy or to determine if utilizing practice-based learning (PBL) in the classroom has a significant difference on performance measures, such as certification board examination scores. In addition, one could assess whether increased use of PBL increases lifelong learning as has been demonstrated in other fields. Factors that have been shown to be enhanced when satisfaction is increased could also be measured such as retention in the field; however, this may be difficult to measure as the majority of respondents in this study were satisfied, and it is known that

genetic counselors leave the field for other reasons, mostly personal. Nevertheless, this could be interesting to pursue in the future.

Another avenue of future research could focus on those who are not satisfied with the teaching techniques used within the training program. While only 6% of this current study population was dissatisfied, a qualitative study involving those 16 individuals could provide additional, rich data. Since this is only a small group, qualitative methods would be ideal to gather further information about these individuals' viewpoints on what specifically was dissatisfying and how improvements could be made in the educational training of genetic counselors.

While this current study focused on satisfaction as the measured outcome, future research assessing additional outcomes that are related to increased satisfaction or testing other outcome variables could be pursued. One could study longitudinal outcomes that have been attributed to increased satisfaction such as retention in the field, lifelong learning, or professional commitment. Although satisfaction is a useful measure, this variable does not lend itself to evaluating the effectiveness of the teaching strategies employed in the genetic counseling training programs. Thus, evaluation of other variables such as self-efficacy or examination scores could provide data about teaching effectiveness.

Perhaps most interesting could be to conduct a similar study with the faculty of the genetic counseling training programs. Previous research has shown that one typically teaches according to one's own learning style; therefore, an assessment of faculty's learning styles could be illuminating and determining how much this influences the teaching methods they individually employ in their respective programs. There are also

tools available to determine teaching styles and it could be noteworthy to evaluate faculty teaching styles and determine if the styles are more in line with PBL teaching versus didactic teaching, as well as whether there are correlations with specific teaching styles and student satisfaction. In addition, this current study was assessing the amount of practice-based learning techniques from the student's perspective, and it could be interesting to ask the faculty how much they feel they use PBL in the classroom and determine congruency between the groups' perceptions.

Given there is a paucity of research being conducted in the genetic counseling training programs, there is ample opportunity for additional research endeavors as this is a largely untapped population. This current study is one step in beginning the discourse about what is occurring within the genetic counseling training programs and to evaluate if there is room for improvements.

Implications for Practice

This study's findings provide an opportunity for those involved in the training programs to perform their own internal evaluations to determine if there are any programmatic changes that would be beneficial to their students. The use of both didactic and PBL teaching techniques varied within the training programs and students within these programs are satisfied. However, the perceived used of PBL increased the level of satisfaction and since the degree of PBL used in the individual programs was not assessed, faculty within the genetic counseling training programs may wish to determine how much PBL is being incorporated into their educational practices. For those using PBL more sparingly they may want to increase the amount of PBL activities in order to enhance student satisfaction.

In addition to evaluating the amount of PBL used within the programs, program directors within the genetic counseling training programs may wish to assess the amount of PBL used within the first year of training. The data from this study indicate that first year students were equally satisfied with the techniques used in the programs, and the data indicate that faculty do not alter the amount of PBL used between the two years of study. Thus, programs that are not using much PBL in the first year may want to evaluate that practice, and those programs that are not utilizing much PBL in the first year of training may consider increasing the amount of exposure to PBL first year trainees receive.

While none of the programs are solely using a PBL curriculum, it could be interesting to create a program that utilizes PBL as the major teaching technique. This would be a major undertaking to shift from a didactic-based curriculum to a largely PBL-based curriculum; however, this has been achieved in other disciplines. This type of shift in teaching philosophy would likely require a major revamping which would necessitate much administrative time for those involved in curriculum development and a commitment to teaching PBL by those faculty involved in the program.

However, it may not be beneficial for the genetic counseling training programs to solely use PBL in their curriculum as varied teaching techniques are beneficial to learners with different learning styles. This study demonstrated that there is not one preferred learning style that is predominant among genetic counseling trainees. Thus, it is not recommended that programs assess learning styles of their incoming students in order to modify their curriculum and teaching practices; however, it may be beneficial to the student in order to gain an understanding of his/her learning style and which teaching

techniques may be more beneficial to them. Because students with different learning styles can adapt to various teaching techniques, using a mixture of teaching methodologies is recommended because this would be advantageous to those enrolled in the programs regardless of their learning style.

Summary

The purpose of this study was to explore the factors that impact satisfaction within the learning environment from the perspective of genetic counseling trainees. Two hundred – seventy – one participants responded to a survey that was disseminated through their respective programs that assessed various elements of education. First, students were asked to rate the amount of varied teaching techniques that were used in their programs with a focus on practice-based learning (PBL) methods versus didactic teaching activities. Second, trainees completed the Genetic Counseling Training Learning Environment Scale (GCTLES) that was fashioned specifically for the purpose of this study. This scale assesses satisfaction from the viewpoint of seven aspects: flexibility, emotional climate, student-to-student interaction, meaningful experience, supportiveness, organization, and breadth of interest. Lastly, participants completed the Kolb Learning Style Inventory to determine each person's learning style as it relates to the classroom as opposed to the clinical setting. Quantitative descriptive statistics as well as structural equation modeling were used to analyze the data gathered from this study.

Several hypotheses were put forth for this study. It was hypothesized that learning styles would impact satisfaction as would perceived used of PBL. It was hypothesized that year of study, i.e. being in the first versus second year of study, would have an impact on learning style, perceived use of PBL, and in turn, on satisfaction.

Individuals with a converging learning style had a higher level of satisfaction than those with an assimilating learning style. This accounted for a small, but statistically significant, contribution to satisfaction. Perceived use of PBL had the most significant finding, as increased use of PBL in the classroom increased satisfaction and accounted for approximately 40% of satisfaction scores. Year of study did not have any correlation with learning style, perceived use of PBL, or satisfaction.

Noteworthy findings from this study include that the majority of genetic counseling trainees are satisfied with the teaching methods utilized in their training programs. In addition, the genetic counseling trainees in this study did not have one predominant learning style, which indicates that programs would benefit from utilizing a variety of teaching techniques to reach the varied learning styles represented in this student population. The findings from this study also indicate that PBL is a general satisfier for these prospective allied health professionals regardless of whether they are in their first or second year of training. Therefore, genetic counseling training programs do not need to alter their use of PBL teaching modalities in order to cater to first-year students as this study demonstrated that even those in the earlier part of their training are satisfied with varied teaching aspects, including PBL. Lastly, genetic counseling trainees are satisfied with the learning environment overall and appreciate most aspects of the learning environment, including the student-to-student interactions, organization, supportiveness, emotional climate, and meaningful experience. Satisfaction also did not differ between the two years trainees are enrolled in their programs, which indicates that programs treat their first- and second-year students similarly.

This is the first study within the genetic counseling field that has assessed the three aspects that were evaluated in this study – teaching methods, satisfaction with the learning environment, and learning styles. As such, this study provides a foundation for future research into the education of genetic counseling students. In addition, this is a population of students within higher education that has been mostly neglected and hopefully this study will bring to light some salient issues that can be evaluated further. Lastly, this study can provide administrators and faculty involved in the training of genetic counseling students a starting point for assessing how their students are being taught and ways to potentially improve the overall education and satisfaction of genetic counseling trainees.

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APPENDICES

APPENDIX A

INFORMED CONSENT FOR PARTICIPANTS

Dear Participant:

You are being asked to participate in a quantitative study conducted by Leslie Cohen, M.S., CGC and Dr. Jonathan Messemer. The purpose of this study is to gain an understanding of how genetic counselor trainees learn, determine the teaching strategies employed in training programs, and to determine the factors that impact genetic counseling trainees' satisfaction with the learning environment. There is one survey for you to complete with several sections. The various sections include basic demographic information, questions about your classes in your graduate school training, the format of these classes, your satisfaction about these classes, and your satisfaction about the learning environment of your program. The last section of the survey is the Kolb Learning Style Inventory (LSI) which is a 12 item questionnaire. Completion of this survey should take approximately 30 minutes of your time. It is hoped that information from this study will contribute to the field of genetic counseling and provide a better understanding of effective teaching modalities for genetic counseling students.

Participation in this study is completely voluntary and you may withdraw at any time. If you are not comfortable answering a particular question, you may refrain from answering. Although you will have the opportunity of winning a gift card for participating in this study, there is no consequence for not participating.

The risks you may encounter by participating in this study are perceived to be minimal and would be no greater than compared to those of daily living. Potential risk may include psychological distress if you are dissatisfied with your graduate training.

Although your responses to the surveys will remain confidential, anonymity will not be preserved as you will have the opportunity to enter into a drawing for one of five $20 gift cards to Amazon.com. In order to be entered in the drawing, you will need to provide your name, your study ID and address in case of winning via Ms. Cohen's e-mail address below. In addition, should you wish to receive your results from the Kolb LSI, you may e-mail Ms. Cohen at her e-mail address below; however, you will need to provide your study ID and an e-mail where you to be notified of your learning style result.

For further information regarding this research please contact Leslie Cohen at (216) 392-5828, e-mail: lcohendissertation@gmail.com, or Dr. Jonathan Messemer at (216) 523-7132, e-mail: j.messemer@csuohio.edu. If you have any questions about your rights as a research participant you may contact the Cleveland State University Institutional Review Board at (216) 687-3630.

In order to participate in this study, you must be 18 years or older. Your consent to participate in this study will be implied when you complete and mail the enclosed survey. Thank you in advance for your cooperation and support.

Sincerely,

Leslie Cohen, M.S., C.G.C

APPENDIX B

APPROVAL TO USE KOLB LSI

Hi Leslie,

Congratulations! Your research request regarding use of the Learning Style Inventory (LSI) has been approved. Attached you will find one document containing three pages(.pdf file--Adobe Acrobat 4.05):

* MCB200C - This is a copy of the LSI test. You may print or copy this document as needed for your research.

* MCB200D - The profile sheet contains the answer key for the test as well as the profiling graphs for plotting scores. This document may also be reproduced as necessary for your research. The AC-CE score on the Learning Style Type Grid is obtained by subtracting the CE score from the AC score. Similarly, the AE-RO score = AE minus RO.

These files are for data collection only. This permission does not extend to including a copy of these files in your research paper. It should be sufficient to source it.

We wish you luck with your project and look forward to hearing about your results. Please email a copy of your completed research paper to Jessica_Menendez@Haygroup.com or mail it to the following address:

LSI Research Contracts
c/o Jessica Menendez
HayGroup
116 Huntington Avenue
Boston, MA 02116

If you have any further questions, please let me know.

Regards,

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APPENDIX C

APPROVAL TO USE DENTAL SCHOOL LEARNING ENVIRONMENT SCALE

Leslie:

Please look over the attached documents – I hope they help.

Just let me know if there are any questions or anything I can do to help.

Thanks,

Dave

David L. Henzi, Ed.D.
Director - Academic Enhancement
Assistant Professor - Ophthalmology
School of Medicine
University of Texas Health Science Center at San Antonio
7703 Floyd Curl Drive, MC 7790
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From: Leslie Cohen [mailto:lesliecohen@roadrunner.com]
Sent: Saturday, May 14, 2011 7:37 AM
To: Henzi, David L
Subject: DSLES

Good morning, Dr. Henzi.

I am a doctoral candidate in Cleveland, Ohio and am currently working on my dissertation that will be assessing student satisfaction within the genetic counseling profession. During my literature search, I came across your 2005 article, *Appraisal of the dental school learning environment: The students' view.* I know you adapted the MSLES to create the DSLES and while I have been searching to find copies of either scale I have been unsuccessful. Hence, I was wondering if you would be willing to share the DSLES so that I could see if the specific questions posed would assist me in my research. I would likely have to adapt the DSLES to fit the training of genetic counselors similar to your initial adaptation of the MSLES. If you are willing to share the DSLES, and if I use any or all of the questions in my research, I would certainly give you credit in my dissertation.

I look forward to hearing from you and thank you in advance.

Sincerely,

Leslie Cohen, MS