2016

Awareness of Clinical Laboratory Sciences and Shortage of Clinical Laboratory Scientists in the 21st Century

Cynthia Funnye Doby
Walden University

Walden University

COLLEGE OF EDUCATION

This is to certify that the doctoral study by

Cynthia Funnye-Doby

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee

Dr. Janet Reid-Hector, Committee Chairperson, Education Faculty

Dr. Kathryn Hollywood, Committee Member, Education Faculty

Dr. Amy Sedivy-Benton, University Reviewer, Education Faculty

Chief Academic Officer

Eric Riedel, Ph.D.

Walden University

2016

Abstract

Awareness of Clinical Laboratory Sciences and Shortage of Clinical Laboratory Scientists in the 21st Century

by

Cynthia Funnye-Doby

MA Ed, National Louis-University, 2004

BS, Eastern Illinois University, 2000

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Higher Education and Adult Learning

Walden University

November 2016

Abstract

Retiring baby boomers and the lack of interest and awareness among college students to enroll in an accredited Clinical Laboratory Science (CLS) program have created a shortage of CLS professionals in the 21st century. The U.S. Bureau of Labor Statistics predicts 18,000 CLS vacancies by 2018. However, only about 5,000 students graduate from accredited CLS programs each year. The purpose of this study was to explore students' perceptions of allied health professions and factors that influenced students and CLS professionals to select CLS as a profession. Bandura's social cognitive career theory served as the theoretical framework for this phenomenological study. Convenient purposeful sampling was used to select the 7 CLS professionals, 5 high school students, and 5 college students in the Chicago area. Participants took part in either a 30- to 60-minute group session or a 45- to 90-minute semi structured interview. Qualitative analysis included open axial coding to identify emerging patterns and themes from the transcripts. Findings revealed that the perceptions of both high school and college students' knew little about the CLS profession, and factors influencing CLS as a career choice included interests in science, health care, and family. CLS professionals indicated their interests in science and a high demand for CLS services in the workforce led them to pursue careers in the field. Implications for social change include improving professional-development programs for student awareness of allied health professions and mitigating the shortage of clinical laboratory scientists.

Awareness of Clinical Laboratory Sciences and Shortage of Clinical Laboratory Scientists in the 21st Century

by

Cynthia Funnye-Doby

MA Ed, National Louis-University, 2004

BS, Eastern Illinois University, 2000

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Higher Education and Adult Learning

Walden University

November 2016

Dedication

I want to begin by thanking God for providing me with the wisdom and words to complete my doctorate in education at Walden University. This project study is dedicated to my family and friends. To my husband, Louis, thank you for your love and the many years of support you offered as I earned my doctoral degree. I could not have accomplished such a task without you. I also want to thank my mama, Darlene, for the times I needed a babysitter for my son, Jacob, during times I was busy writing and or had an oral presentation or conference call with my chair. I thank you too, Jacob, for the many times we visited the library so that I could find research articles, and you patiently did your homework. Thank you! My granny, Verdelle Funnye, our family matriarch, would have been so happy that I had completed this doctorate in Higher Education and Adult Learning (HEAL) at Walden University. I miss you granny and wish you were here for the graduation ceremony. My family believes in accomplishing dreams and goals. Education is my family's greatest vision for all generations. Education is my passion, and now that the doctorate in education is complete, I have accomplished a lifelong dream. My greatest joy is love and happiness of family. I love you all and thanks for the support.

Acknowledgments

I would like to thank Dr. Janet Reid-Hector for her encouragement and the many phone calls she would take day or night. I can never adequately express my gratitude for her support. I would also like to thank the directors and administrators who provided me with letters of cooperation so that I could include their staff or students in my study: for Hector, Hollywood, and Sedivy-Benton who served as my chairpersons, URR, and mentors who encouraged me throughout this project. A special thanks to Dr. Reid-Hector for her wise guidance. Thank you Marilyn, director of Ingalls Hospital Laboratory, for all the support. In addition, I would be remiss if I did not acknowledge Dr. Flaws, Rush Clinical Laboratory Science director, and Dr. Evans, Thornton North High School principal. Thank you all for your support.

Most importantly, I would like to acknowledge my Lord and Savior Jesus Christ who in the process of this project, through the Holy Spirit, led and guided me in the understanding of knowing when to recoil and when to go ahead in writing to complete my doctorate in education.

Table of Contents

List of Tables

List of Figures

Section 1: The Problem

Hospitals and college administrators have become interested in and concerned by the increase in baby boomers retiring from the clinical laboratory science (CLS) profession (Kaplan & Burgess, 2011). Colleges and hospitals will have to address the drastic shortage of CLS professionals in a timely manner to ensure patients' scope of care is not affected. According to Malone (2011), the increase in retirement of baby boomers makes it evident that a shortage exists. Laboratory directors are struggling to fill CLS positions, and current efforts to overcome the shortage are underway. According to Maddox (2011), the lack of science education in K-12 has led to student disinterest in science professions. Lack of science education is the root cause of the labor shortage of laboratory scientists in the United States.

The U.S. Bureau of Labor Statistics (BLS, 2010) indicated the United States should expect 81,000 new clinical laboratory positions to be added between 2008 and 2018. For clinical laboratories to meet the medical needs of the population, the U. S. Department of Labor projected approximately 15,000 students would be needed each year through 2014; however, currently only 5,000 individuals graduate from accredited educational programs each year (National Accrediting Agency for Clinical Laboratory Sciences [NAACLS], 2011). According to Dianne Cearlock, CEO of NAACLS (as cited in Ernado, 2009), "The current vacancy rate in the clinical laboratory sciences field is 13%. In the next 5 years, 13% of the workforce is expected to retire, with 25% of the workforce retiring over the next 10 years" (pp. 1-2).

According to the American Society for Clinical Pathology, the outlook is even worse. The American Society for Clinical Pathology (as cited in Crowley, 2012) predicted 40% of the workforce in clinical laboratories would retire in the next 10 years. The clinical laboratory departments most affected by the shortage are microbiology, chemistry, immuno-hematology, hematology, immunology, coagulation, and molecular diagnostic laboratories (Crowley, 2012). In Central Northeast regions, specifically in Chicago area hospitals, the vacancy rate is highest for phlebotomy departments (8.0%), specimen processing (18.0%), supervisory retirement (24.0%), and lowest for cytogenetics, immunology, histology, as well as laboratory safety personnel (Garcia, Ali, & Choundry, 2013). Although current research is not available on the topic, as of 2015 the shortage of laboratory personnel will likely have a negative impact on the care and treatment of patients (Thornton, 2011).

Factors found to contribute to the shortage of laboratory personnel include the rising number of older individuals in the population, cuts in CLS programs, and lack of appeal or awareness of CLS programs among students (Crowley, 2012). The increase in the number of older individual's means not only that large numbers of baby boomers currently occupying these positions are retiring, but also that as the older adult population grows, a group with greater health-related complications will increase and the number of allied health professionals and clinicians needed to provide health care services will rise.

Crowley (2012) argued the shortage of CLS graduates is directly related to student enrollment and retention in hospital-based CLS programs. Administrators who decide to close accredited CLS programs, presumably for financial reasons, do not

understand that closing accredited programs is a significant reason for the drastic shortage of credible laboratory scientists (Crowley, 2012). According to Ghazarossian (2010), opening more training programs and increasing public visibility would help alleviate the shortage. Generation X and Y students, according to Fried and Fotler (2011), appeared more interested in work that accommodated their families and personal lives. Therefore, recruitment and retention of this population of students are critical in addressing the shortage of laboratory scientists. The success of retention depends on the ability of the company to research causes of turnover of staff and to enact strategies that appropriately target these causes (Fried & Fottler, 2011).

Malone (2011) suggested the ability to correct shortages is directly linked to the earnings of laboratory professionals as compared to other medical professions. According to Malone, strategies that health care organizations could use to recruit CLS students include career progression programs, mentoring and professional development, increases in salary, connecting people with social networks, and providing financial remuneration to students who enroll and complete the program. Some of the factors Crowley (2012) found to correlate with job search motivation and career choice included life satisfaction, self- and environmental exploration, and decision-making, which is conceptualized both in terms of process (individual or collaborative) and in terms of stress associated with making a career decision. Further, in describing successful career exploration strategies, workers who expressed high levels of job satisfaction cited exposure to role models, career awareness, and communication of the profession, vicarious learning, and previous work experience as helpful factors (Tudge & Winterhoff, 2010). Individuals who

reported high levels of job satisfaction were influenced by two of the four primary sources of self-efficacy, including previous accomplishments and role models/vicarious learning), in the domain of occupational exploration (Tudge & Winterhoff, 2010). The purpose of study was to address the local problem and factors that directly relate to increasing the awareness of the CLS profession to students in the 21st century.

Definition of the Problem

The growing shortage of clinical laboratory scientists (CLS) is a problem across the United States, specifically at the local level in Chicago. The American Society of Clinical Pathology-Board of Certification in Chicago, Illinois (as cited in Garcia et al., 2013) reported an 18.8% vacancy rate within clinical laboratory departments in the Central Northeast region of the United States. This shortage has caused laboratory administrators in Chicago to develop creative measures to staff clinical laboratories. These numbers may not seem extreme for some laboratories in other regions, but for a region as large as Central Northeast, the vacancy rates present concerns for Chicago laboratories, especially with the increase in laboratory testing requested by physicians. In an effort to address the shortage of CLS professionals, I identified factors that would increase the awareness of CLS professions among high school students in Chicago by implementing a CLS awareness professional workshop to high school science teachers. The increase in baby boomers retiring from CLS may cause a significant shortage of competent laboratory scientists in the profession (Small, 2013). Additionally, there will be a drastic shortage of qualified laboratory science educators in the future (Kaplan & Burgess, 2011). According to McClure (2009), studies on health care shortages in allied

health professions have focused on the health care workforce shortage generally, as opposed to focusing on the related factors that prevent students from enrolling in accredited CLS programs, and pursuing careers as clinical laboratory scientists. Kaplan and Burgess (2011) found more than 70% of programs teaching this critical profession have closed. The population of students that will affect the drastic shortage of laboratory scientists is the next generation of learners including high school and college students ranging from 14 to 21 years of age. According to Alexander and Sysko (2011), as retirement of the silent generation is nearly completed and the baby boomer generation retires, ways to attract individuals from Generation X and Generation Y to the field must be identified. Table 1 shows details on the different generations and the years in which they were born.

Table 1

Progression of Generations

Name of generation	Birth years
Silent generation	1922-1945
Baby boomers	1946-1964
Generation X	1965-1981
Generation Y	1982-2000
Generation 9/11	2001-Present

Note: Source: Lab Medicine (Alexander & Sysko, 2011)

According to the Medical Laboratory Observer (2011), the following groups experienced a severe shortage of health care professionals and allied health programs: (a) clinical laboratory scientists, (b) dentists, (c) emergency medical technicians, (d) physical therapists, (e) physicians, (f) dental hygienists, and (g) nurses. Laboratory professionals usually find themselves organized into five clinical departments and six major sectors of

staff. Laboratory staff members consist of CLS, cytotechnologists, histotechnologists, CLS supervisors, phlebotomists, and pathologists (Medical Laboratory Observer, 2011). The clinical laboratory departments most affected by the shortage are hematology, microbiology, histology, cytology, microbiology, chemistry, and immunology (Medical Laboratory Observer, 2011). Laboratory scientists provide physicians with lab results from body fluids for the diagnosis and treatment of disease.

McClure (2009) attributed the shortage of scientists in the profession to a lack of communication from high school and college administrators, a lack of career opportunities, impressions about the career, skills needed at entry level, and failure to find ways to attract elementary, high school, and college students enrolling in allied health training programs or universities. McClure presented factors that contributed to the workforce shortage at various stages of life, as outlined in Figure 1 (Source: Clinical Leadership and Management Review).

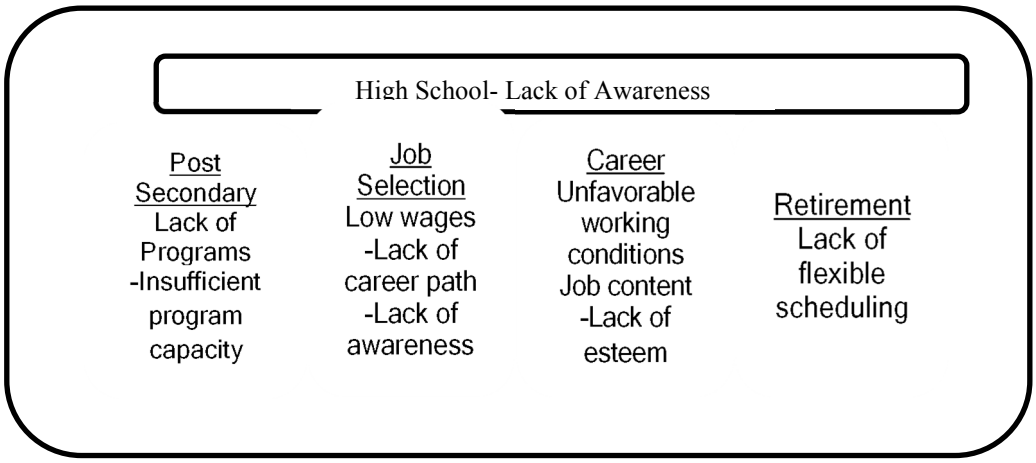


Figure 1. Factors contributing to the workforce shortage at various stages of life.

According to Crowley (2012), young people saw health care as a low-technical profession. High stress due to taking care of patients with life-threatening illnesses, extensive math and science classes, and time for training were deterrents that caused low enrollment in CLS and health care professions. With the increase in closures of CLS programs and retirements of laboratory scientists in the field, hospitals and colleges will be without competent scientists and facilitators to support the number of patients and staff at the forefront of medicine (Garcia & Fisher, 2013). Enhancing the visibility of low student enrollment and college awareness of the program may reduce the shortage of laboratory scientists and the anticipated delays in laboratory testing that may result from a shortage. The lack of awareness of a career as a laboratory professional among high school students is especially significant because this stage of life is when many young people begin to make choices about their career paths (Kaplan & Burgess, 2011). The lack of qualified workers in clinical laboratories will affect the efficiency and quality of patient care, as well as impede appropriate actions in response to health threats in the future (McClure, 2009).

Kaplan and Burgess (2011) suggested youth are not interested in laboratory medicine as a profession because of the position's lack of enticement to younger-generation students. To improve youth interest, employers are looking at ideas to increase the career hierarchy and salaries for laboratory scientists (Baker, 2013). Researchers suggest one possible way to spread information on the topic is through community education, a valuable academic program that can allow students to explore allied health careers and identify a health profession of interest (Massiha, 2011; Sasnett, Royal, &

Ross, 2010). Laboratory scientists and educators consider the field invisible to many students because of a lack of knowledge about the academic programs and career opportunities that exist.

According to Kaplan and Burgess (2011), the public believes laboratory scientists are phlebotomists or doctors, highlighting the lack of knowledge of career opportunities in the field. It is important that high schools, colleges, and laboratory administrators implement marketing strategies to attract students to enroll in CLS programs. However, the high rate of closure of accredited CLS programs will limit the amount of disease diagnosis training that students can receive. The scarcity of accredited programs and the lack of CLS knowledge are contributing to the shortage of employed laboratory scientists and educators (Kaplan & Burgess, 2011). The NAACLS has implemented a task force to assist hospital and college programs with the accreditation process. The task force program will either increase the number of schools and hospitals becoming accredited by the NAACLS or will assist in preventing program closures by providing workshops and additional educational courses on the accreditation of laboratory programs with NAACLS.

According to Alexander and Sysko (2011), Generation X and Y populations are more interested in work that can accommodate their families and personal lives; they are not interested in the stress of caring for people with complex illnesses. The CLS profession is one specialization in the spectrum of allied health professions that many consider a hidden workforce that keeps the flow of patients moving through every type of health care setting and has potential to influence all health disciplines (Palumbo, Rambur,

Mcintosh, & Naud, 2008). To prevent the excessive shortage of laboratory professionals for the next generation, government officials have begun to implement incentive programs, such as student loan repayment and loan forgiveness programs, to attract and retain students in CLS programs. Loan repayment and loan forgiveness are two incentive programs to increase the number of students enrolling in accredited programs and to increase the number of guaranteed laboratory professions in the hospital sector for five years (McClure, 2009). According to McClure, scholarships and grants are also incentives to attract students to study CLS.

Rationale

The rationale for the study was directly related to the local shortage of laboratory scientists, and the issues that will emerge in health care because of the low numbers of students enrolling in accredited CLS programs. With the increase in cancer, arthritis, and other illnesses, the demand for laboratory testing will increase (Crowley, 2012). According to Crowley (2012), this may lead to a corresponding increase in turnaround time (TAT) for completion of diagnostic laboratory tests. The Bureau of Labor Statistics (2010) expects employment of clinical laboratory workers to grow by 14% between 2008 and 2018, which is faster than the average for all allied health professionals. As outlined in Table 2, the dire shortage of laboratory scientists to perform testing on critically ill patients will increase the number of tests sent to reference laboratories.

Table 2

Projection Data from the National Employment Matrix

Occupational title	SOC code	Employment 2008	Projected employment, 2018	Change, 2008-2018	
				N	%
Clinical laboratory technologists and technicians	29-2010	328,100	373,600	45,600	14
Medical and clinical laboratory technologists	29-2011	172,400	193,000	20,500	12

Note. Source: Bureau of Lab Statistics, 2010.

Technological advances such as the inclusion of auto verification of results into the laboratory information system and an increase in automation will ease the workflow struggles that laboratories face (Nace, 2012). Sending laboratory specimens to outside laboratories for testing reduces the TAT for physicians to obtain results for diagnosis, treatment, and care of patients. However, even with the advent of electronic health medical records, which interface results to physicians' offices, the shortage of laboratory scientists may prevent testing and the laboratories may not release results to patients' medical records if there are not sufficient numbers of competent scientists in the hospitals to perform testing. The delay in physicians obtaining results is often due to the shortage of scientists who perform the testing in hospital laboratories (Nace, 2012).

The accreditation of hospital-based CLS programs will likely affect the shortage of laboratory scientists. According to Szabo (2011), having additional hospital programs in rural and non-rural areas may decrease the staffing shortage. Implementation of these programs could reduce the severe shortage of scientists in rural areas, especially as laboratory supervisors and managers have the opportunity to use students to fill positions.

To create effective programs, it is necessary to understand what draws students to, and retains them in this field.

To prevent shortages of laboratory personnel, there needs to be concerted efforts to communicate the desirability of this professional opportunity, especially to elementary, middle school, high school, and college students (Thornton, 2011). To reduce the shortage, experts must create and implement programs effective in recruiting and retaining students in the field. Educators must address this issue sooner rather than later, given that educating students in these fields takes time. Baby boomers are beginning to retire, and if hospital administrators do not seek solutions now, a delay will occur in training new students, resulting in poor working conditions for those who are in the field; further, patients may not receive immediate necessary medical treatment (Thornton, 2011). Clinical laboratory science is an important profession in health care, and science educators could reduce a drastic shortage by making all students aware of the profession.

Definitions of Special Terms

Allied health. Health care professions excluding physicians, nurses, dentists, or podiatrists. Allied health professionals are the medical practitioners who support medical professionals, including clinical laboratory personnel, physical therapy, occupational therapy, dietetic services, medical record personnel, radiology services, speech-language, pathology and audiology, and respiratory therapy (Kaplan & Burgess, 2011).

American Society of Clinical Pathology (ASCP). Formed in 1928 to certify individual laboratory technicians and scientists and to standardize educational training of laboratory personnel (ASCP, 2012).

Clinical laboratory scientist (CLS). Health care professionals who perform chemical, hematological, immunologic, microscopic, and bacteriological diagnostic analyses on body fluids such as blood, urine, sputum, stool, cerebrospinal fluid, peritoneal fluid, pericardial fluid, and synovial fluid (Kaplan & Burgess, 2011).

Generation X. Those born between 1966 and 1976. This is the first generation with increased exposure to day care and divorce (Ball & Gotsill, 2010).

Generation Y. Those born between 1977 and1994. They are incredibly sophisticated with regard to technology (Ball & Gotsill, 2010).

Generation Z. Those born in the early 2000s. This generation will be highly sophisticated with media and computers (Ball & Gotsill, 2010).

Incentive programs. Programs funded through the government or private societies that promote or encourage students to enroll in a laboratory science program (Scott-Clayton, 2011).

National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). An agency dedicated to being the premier international agency for accreditation and approval of educational programs in the CLS and related health professions through the involvement of expert voters and dedication to public service (NAACLS, 2011).

Significance

The shortage of laboratory scientists may affect the quality of patient care. Researchers in the field have focused on workforce shortage in laboratory medicine, but have leaned toward state incentive programs to increase enrollment and retention of students in programs (Malone, 2011). There have been few studies devoted to the

awareness of and communication about the laboratory profession and few studies on graduate education in CLS (Butina, 2010). There have been few studies on the evaluation of online learning for CLS programs (Price, 2010). The present study contributes to the existing body of literature by filling gaps in knowledge by communicating, and making individuals aware of the CLS profession by showing how the shortage of laboratory scientists affects the diagnosis and treatment of patients.

Using Bandura's (1986) social cognitive adult learning theory as the theoretical framework, I endeavored to show how this theory, along with social cognitive career theory (SCCT), could support the identification of personal characteristics and environmental factors in the selection of CLS as a career path (Sheu, Kang, Lin, & Lin, 2010). Organizations, hospitals and national certification agencies may use the results of this study to identify strategies to enhance awareness of the CLS profession to students. This is particularly important given that nearly 50% of laboratory scientists are age 50 or older and the larger national laboratory workforce shortage will become serious as the number of retirees increases (ASCP, 2012). The community faces the pressure of baby boomers retiring, and the number of senior citizens in 2030 could reach 50% of the population (Peer Science Self-Efficacy: A Proximal Contextual Support for College Students' Science Career Intentions *Journal of Career Assessment 1069072716651620, first published on May 25, 2016* 10.1177/1069072716651620 *Journal of Career Assessment May 25, 2016 106907271665162* , 2011).

There is concern regarding how the shortage of allied health professionals, including laboratory scientists, will affect the treatment, diagnosis, and care of patients.

Program closures are a particular concern. According to Maddox (2011), between 1975 and 2009, the number of accredited CLS programs went from 709 to 219, a 69% drop. The closing of accredited CLS programs reduces the number of graduates needed in the laboratory workforce. Given the reduction in those entering the profession, retaining interested students through graduation is increasingly vital. To retain students, a strategic plan for recruitment and retention is necessary, and the results of this study may provide a basis for such a plan. The aim of this study was to provide preliminary findings to address this problem.

Problem Statement and Research Question

In recent years, colleges and universities have eliminated two thirds of their CLS programs, resulting in a proportionate reduction of graduates. The severe shortage of laboratory scientists could produce serious problems, from an increase in TAT for patient testing to errors in testing, influencing patient safety and care (Sheu, Kang, Lin, & Lin, 2010). Flores (2010) argued the preparation of qualified graduates from allied health programs would help to prevent the shortage of personnel in health care professions.

I conducted this study in response to a lack of information regarding current student perceptions of the field, what attracts students to the field, and the projected consequences of the shortage. The aim of the present study was to gather this information directly from students and scientists. I used a qualitative methodology to gather rich information from these sources and provide in-depth data regarding the topic. The purpose of this study was to explore high school students' understanding and perceptions of allied health professions, factors that influence college students in CLS-related

programs, factors that influenced CLS professionals to select CLS as a profession, and the anticipated consequences if educators do not adequately address the shortage. The research questions (RQs) were the following:

RQ1: What are high school students' understanding and perception of the allied health profession?

RQ2: What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program?

RQ3: What are the factors that influence CLS professionals' awareness and pursuit of the profession and what factors relate to their longevity in the profession?

Theoretical Framework

Creswell (2012) defined theory as an interrelated set of constructs formed into hypotheses and supported by evidence for describing a phenomenon. A theoretical framework is the researcher's conceptual perspective of why the research problem under study existed and theories formulated to support the research (Merriam, 2010). I used Bandura's social cognitive theory as the framework for this study because it directly informed the canon of knowledge on human behavior related to the environment and propose that people learn from one another via direct observation and motivation which guides the individual to act upon those behaviors to determine their life outcomes in society.

Social Cognitive Theory

Social cognitive theory was Bandura's (2001) attempt to explain human thought and behavior. Bandura argued individuals are neither completely controlled by their

environments nor are they able to exercise absolute freewill. Rather, their environment shapes them, but at the same time, they affect the environment as well, with both personal and behavioral factors in play.

Future generations of science students who choose, or do not choose CLS as their major in college will do so mainly because of people around them who educate them regarding the profession and the importance of a career in CLS (Massiha, 2011). Many students choose college majors in other allied health professions such as radiology, physical therapy, or occupational therapy because there is greater awareness of these professions among high school and college students (Massiha, 2011). Clinical life science is less known to students, and educators may not mention it as a respected career option to future science students. Increased awareness of CLS and enhanced communication with prospective students may assist hospitals in their efforts to address the anticipated shortage of future CLS.

The choice of CLS as a career is influenced by an individual's perceptions of the career. Individuals who portray the profession negatively or positively influence students' perceptions of the career. Other factors that may influence students' choices of a career include flexibility, career growth, salary, family lifestyle, and suitability (Szabo, 2011).

Bandura (2001, 2011), referred to the relationship between personal factors, outward behavior, and environment as *triadic reciprocity*. Further, the relationship between any two of the three variables is bidirectional, meaning neither the individual nor the environment is static. Bandura also noted the differential strength of each of the three factors, depending upon the situation. Because of the reliance on both personal and

contextual variables, along with the assertion that the person and the environment are in states of continual change, Bandura's social cognitive theory provided a logical framework upon which to base a theory of career development, as Sheu et al. (2010) did with SCCT.

Social Cognitive Career Theory

The refined SCCT theoretical framework directly related to the investigation of the relationship between lack of awareness and shortage of CLS professionals in the 21st century (Sheu et al., 2010). Social cognitive career theory (SCCT) was particularly suitable for investigating the career decisions of students in high school and college and their reasons for choosing, or not choosing CLS as a career option. SCCT focuses on the students and their ability to make a cognitive decision on their career, instead of a career choice selected by chance or just by luck of the draw (Sheu et al., 2010). Cognitively choosing the best-suited career encourages students to progress and stay in the profession (Szabo, 2011). The environment and people with whom students socialize are influential factors in the career choice. For example, if there is a friend or family member who is in the CLS field, the student is more like to be educated regarding the profession and the path taken in choosing the field (Szabo, 2011).

The primary theoretical framework for this study was Bandura's (1986) social cognitive career-awareness theory. Bandura's (2001) SCT provided a framework to examine the relationships among social, affective, and cognitive factors with respect to young adults' career awareness of CLS. These three cognitive dimensions include several variables. Economic, social, and cultural backgrounds are examples of the social

dimension; motivation, enjoyment, self-efficacy, beliefs, and attitudes represent the affective dimension; and describes the cognitive variable dimension for SCCT. The economic, social, cultural backgrounds, motivation, and academic achievement were some of the variables explored during the interview process with students and clinical laboratory scientists. The two dimensions of SCCT are economy and society, which contribute to students not enrolling in accredited CLS programs and may explain why the retention of laboratory scientists in the profession is declining. Figure 2 illustrates factors that affect students' decisions in choosing CLS as a career (Sheu et al., 2010). Social Cognitive Career Theory (SCCT) aimed at explaining five interrelated aspects of career development: personal inputs, self-efficacy, contextual influences proximal to choices, background/context and outcome expectations.

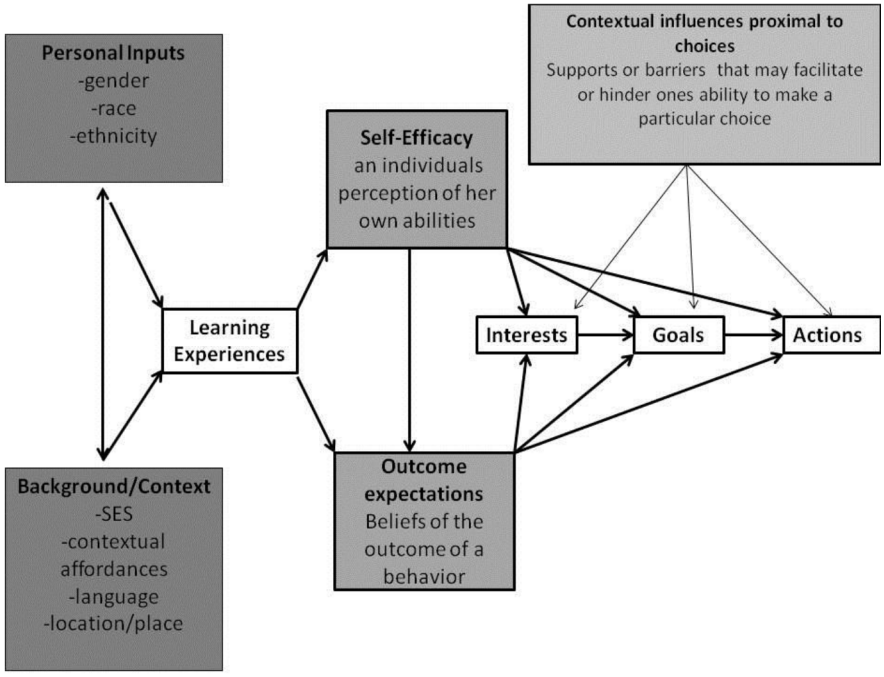


Figure 2. Social-cognitive career theory model of *performance.*

According to Bandura (1986), self-efficacy played an important role in determining an individual's behavior because feelings of confidence with respect to a specific problem were crucial to an individual's capacity to solve the problem in society and improve social change. Efficacy beliefs influence academic motivation and aspirations, levels of interest in intellectual pursuits, scholastic achievements, and academic goal persistence (Bandura, 1986). Positive academic efficacy beliefs can raise educational expectations, which can support academic success (Bandura, 2001). Students choosing CLS as their career choice did so because of underlying factors such as economic stability, career growth, and strong efficacy beliefs, along with fundamental learning tools supplied by formal education in math and sciences, resulting in CLS students who possessed skills necessary for social and economic stability (Sheu et al. 2010). A sense of personal efficacy influences self-directed lifetime learners who are valued and economically rewarded in today's society (Sheu et al., 2010). A lack of awareness, communication, exposure, and confidence to succeed as a CLS professional may hamper academic and career success. Exposure to other laboratory scientists and CLS programs is essential to promote academic achievement and CLS as a career choice (Massiha, 2011).

I expanded Bandura's (2001) social cognitive theory to include academic performance with the development of SCCT (Sheu et al., 2010). The word *career* used in SCCT refers to academic interest, choice, and performance. Social cognitive career theory provided a framework for explaining both academic and career behaviors. According to social cognitive career theory, academic progress is a developmental

complement to career interest and choice (Sheu et al., 2010). SCCT emphasizes three social variables that may be relevant to academic development: self-efficacy, outcome expectations, and goals.

According to Bandura (1986), self-efficacy influences the effort and perseverance students devote to academic tasks and affects their achievement. Researchers explored the relationships between student confidence, college majors, and career choices, particularly in the areas of science and mathematics (Massiha, 2011). Sheu et al. (2010) and Casina (2011) reported mathematics self-confidence in college undergraduates was predictive of their interest in mathematics and their choices of math and science-related courses. This indicated students' self-confidence and perceived efficacy played a highly influential role in career choices and occupational pursuits (Tudge & Winterhoff, 2010). However, the social cognitive theory's model of performance has not been extended to the study of academic performance of undergraduate students enrolled in a CLS program. Social cognitive career theory includes outcome expectations as the desired consequences of a course of action and goals as the effort required to engage in an activity. The theoretical framework appears on three interlocking models, including (a) interest development, (b) goals or choice, and (c) actions/performance (Sheu et al., 2010).

In identifying possible sources of student confidence in academic tasks, researchers also examined factors and experiences that can boost academic confidence (Sheu et al., 2010). Abele and Spurk (2009) reflected on "occupational self-efficacy and career advancement goals, based on both objective and subjective career choice that will meet the student's contextual influences, such as personal interests, salary, goals, and

outcome an exceptional" (p. 54). By being self-efficient, the student will meet contextual influences such as personal interests, goals, and outcomes including an exceptional career as a CLS. In support of SCCT (Bandura, 2012), researchers suggested previous performance and experiences, including the quality of learning environments to which students were exposed, can influence student confidence (Sheu et. al., 2010). Subject-related enjoyment influences students' academic motivation, performance, course selection, and career pursuits (Bandura, 2001). Social cognitive career theory, expanded by Sheu et al. (2010), shows a direct relationship between the underlying factors for the shortage of laboratory scientists in the new generation and scientists choosing CLS as a career choice. Students must be aware of the CLS field in order to pursue it; if they are unaware, uneducated, or not motivated to become accredited laboratory scientists, they will not select the profession. Students becoming aware and conscious of their educational opportunities may increase their motivation and societal impact (Baker, 2013).

Bandura's SCCT indicated people learn about career options through observation and environmental influences, but learners are only self-efficient if they perceive the potential to be competent and successful in the particular environment (Sheu et al., 2010). Students learn the importance of having credible people in a profession from others in their communities; learning that the profession of CLS is necessary for assisting physicians in diagnosis of disease through examination of bodily fluids may encourage students to learn more about the profession (Massiha, 2011). It is the student's motivation to become more aware of and educated regarding the profession that will influence him

or her to take action, enroll, and remain in one of the allied health professions, such as CLS.

Potential threats to student motivation to learn about a career in CLS include internal, personal, and external environmental factors. Some of the internal factors include counselors, family members, or close friends who are not aware of the profession (Ball & Gotsill, 2010). Lack of awareness among these key individuals reduces students' knowledge of the profession. Personal factors like students' level of comfort or fear of taking science courses, such as biology and chemistry, may contribute to inadequate enrollment in professional courses (Sheu et al., 2010). A student who is not comfortable in science or math might not be interested in enrolling in CLS in college or at a university. Students not interested in science or math may not have interest in learning about career opportunities in CLS.

Students interested in science and math may interact with other students who are majoring in CLS. Observing the experiences of the CLS students may enforce a positive impression of a career in CLS and increase the desire to pursue a career. Other personal factors may relate to the job itself; after researching the profession, students may conclude it does not provide enough growth opportunities, or the salary may not match what students expect for the cost and extensive course work required in college (Bandura, 2011). Environmental factors could keep students from enrolling in CLS. These might include the (a) stability, (b) achievement, and (c) satisfaction an individual may achieve in a job as a CLS (Sheu et al., 2010).

The projected shortage of CLS professionals is not only a future problem; it is a current problem nationwide (Kaplan & Burgess, 2011). Through educating and raising awareness among elementary, high school, and college students regarding the CLS profession, stakeholders can make strides toward curtailing the shortage in the field. It is vital to make students more aware of the CLS shortage as a global issue and one that can affect large segments of the population, especially if there are not sufficient clinicians to assist doctors with the diagnosis and treatment of diseases (Sheu et al., 2010).

Review of the Literature

This review results from a search of the following EBSCO databases**:** (a) Academic Search Premier, (b) Master FILE Premier**,** (c) Business Source Premier, (d) ERIC, (e) Communication & Mass Media Complete, (f) Psychology and Behavioral Sciences Collection, (g) Psyc INFO, and (h) Psyc ARTICLES. The key words included *clinical laboratory*, *medical laboratory*, *medical education*, *student awareness*, *histology*, *hematology*, and *clinical laboratory scientists*. In the literature review, I examine efforts made to recruit college students into the field of medical laboratory work to address chronic shortages in the field.

I examined the chronic shortage of scientists faced by clinical laboratories and the reasons for this shortage. I addressed factors both intrinsic and extrinsic to the field. Part of the review focused on the changing nature of the field and the inherent challenges that accompany a profession in transition. The latter portion of the review focused on the existing models to promote the allied health sciences to high school students through curricular and cocurricular experiences. The review of the literature concluded with a

summary of the existing gaps in the research with regard to the existing challenges of the field, and the recruitment efforts designed to promote the profession.

Recruitment Challenges for the CLS Profession

Zaleski (2011) reported the shortage of qualified laboratory professionals worsened from a matter of concern into a crisis from July 2002 to July 2012, with vacancy rates in 2002 ranging from 6% to 10% that are now approaching 43%. According to Zaleski (2011), the specialties with the highest vacancy rates were blood banking (11.6%), chemistry (8.6%), hematology (7%), and microbiology (6.8%). One estimate indicated by the end of 2012, the industry would need 138,000 laboratory professionals, while it would have only 50,000. Alexander and Sysko (2011) described a number of efforts focused on recruiting more students by professional associations linked to the field, but they were not successful. Alexander and Sysko also addressed the increasing problem linked to labs hiring noncertified personnel and efforts to engage in de facto downsizing by allowing vacancies that went unfulfilled to be withdrawn and left empty, leaving the department staff laboratory scientists to handle more work on their shift. Further, there was no anticipated resolution to this shortage, as there were insufficient numbers of students studying these professions to help fill these gaps (Alexander & Sysko, 2011)

Kibak (2008) described the Labs are Vital program from Abbott Laboratories as a recruitment program that stresses the role of clinical laboratory professionals in medical teams and the need to recruit and retain CLS professionals to address the continued shortage in this field. The goal of such programs is to educate and attract young people to

the profession. Despite efforts such as Labs are Vital, Kibak noted a serious shortage in the clinical laboratory workforce, with projections now indicating that to meet laboratory needs, there was a projected need for 21,000 more clinical lab technicians by 2016. Further, not only will the number of people retiring be an enormous loss for laboratories, more importantly the loss of collective years of knowledge in laboratory science that individuals possess will be staggering (Kibak, 2008).

Baker (2013) estimated the current annual needs of medical laboratories exceeds the current ability of schools to produce laboratory workers by a ratio of 2 to 1, with only 5,000 graduates to fill 10,000 positions. An attrition rate of about 5% during the first 5 years of laboratory work makes this ratio even worse. The overall vacancy rate for laboratory generalists was about 6%, representing a reduction from 2000 when it was up to 15%; this was likely due to economic downturns in which health care careers looked better to prospective employees between 2000 and 2008. Added to the problem with laboratory employment was the fact that the average age of a laboratory professional was more than 45 years, which will result in waves of retirement from 2005 to 2020.

Chronic problems in laboratory work exacerbated the shortage of clinical laboratory science professionals (Baker, 2013). Ongoing problems included the lack of clear distinctions between CLS professionals and clinical laboratory technicians (CLT) and conflicts in staffing accommodations between CLS and CLT staff, with CLS staff feeling underutilized and CLT staff feeling as if they did the same job for less pay. The fact that most labs also need to hire non-licensed personnel to fill vacancies, diminishes staff morale (Baker, 2013). Attrition from laboratory professions was also attributed to

the fact that the salaries for laboratory technicians lagged behind other comparable health professions and have barely kept pace with inflation since the 1970s. A physical therapist makes on average $61,000 per year, a nurse makes $52,610 per year, a CLS/MT (medical technology) professional makes about $45,000 per year, and a CLT/MLT (medical laboratory technical) professional makes $31,000 per year (Baker, 2013). The following sections in the literature review address the reasons for vacancy rates of within the allied health profession.

Multiple professions within allied health. The U.S. Bureau of Labor Statistics (BLS) vacancy survey predicts that by 2014 approximately 81,000 technician and technologists position vacancies will need to be filled after many in the roles retire (BLS, 2010).included staff and supervisory data. According to ASCP (2012), vacancy rates across the United States were highest for blood banking (11.6%), histology (9.81%), and chemistry 8.62%). Wage and salary trends were developed for a number of types of clinicians employed in labs, including staff medical technologists, staff cytotechnologists, histotechnicians, histotechnologists, staff medical laboratory technicians, staff phlebotomists, laboratory assistants, and supervisors of various kinds. The survey indicated specialists in blood banking as a new specialty in labs (ASCP, 2011).

The average wage for MT staff-level employees was $23.00 per hour, with large hospitals likely to pay more than small hospitals. Medical technology supervisors earned $28.00 an hour, while MT managers made $34.00 an hour (Crowley, 2012). Medical laboratory staff employees made $18.48 per hour, while supervisors made $21.90 per hour (Crowley, 2012). Cytotechnologists made $27.90 per hour, histotechnologists (HT)

earned $23.46 per hour, and laboratory assistants made $13.50 per hour (Medical Laboratory Observer, 2011). Though pay levels for medical laboratories were generally low, specialists with technological skills earned more (Medical Laboratory Observer, 2011).

With regard to shortages, the vacancy rates were highest for non-managerial staff, including 10.4% for MT positions and about 8.0% for HT and HTL positions (Crowley, 2012). There was almost no shortage of supervisors. Private clinics or reference laboratories reported the highest shortage rates, with shortages highest in physician offices and outpatient clinics. The highest shortage rate was for medical technologists, at 10.4% across all positions. Forty three percent of clinical laboratories reported difficulties in hiring personnel, with hospitals experiencing the most difficulty hiring qualified staff (ASCP, 2012).

Additionally, 69% of clinics reported difficulties hiring staff for the day shift, 39% reported difficulty filling night shifts, and hospitals experienced the opposite pressures (ASCP, 2012). Hiring staff-level MT positions was problematic for 63% of clinics surveyed. Most clinics, however, filled posts within six months of posting an opening. One fifth of all labs reported increased staff-level turnover in most clinical positions as well (ASCP, 2011). The fact of many baby boomers retiring "poses yet another staffing challenge for the clinical laboratory field" (Medical Laboratory Observer, 2011, p. 30), with retirement projections ranging from 9% to 17%.

The ASCP (2012) also noted that the Clinical Laboratory Improvement Amendments of 1988 might have had a long-term negative impact on the profession by

allowing laboratories to hire previously unqualified individuals at lower wages to perform basic tests. According to Aira, Mantyselka, Vehvilinen, and Kumpuslo (2010), "this change in hiring criteria for laboratory personnel, coupled with a declining interest in laboratory medicine as a career over the past two decades, has led to the closure of numerous medical technologist training programs" (p. 141). This also means students with a limited interest in the laboratory field had limited opportunities to pursue that interest. Aira et al. (2010) compared the shortage of clinical laboratory technicians to the nursing shortage and recommended adopting a multifaceted recruiting approach like the one used to attract more nurses to the field. Stressful work conditions exist in medical laboratories and may increase the shortage and contention of the work environment. In summary, the vacancy rates of laboratory scientists directly relate to lack of awareness and stereotypes of laboratory personnel.

Lack of awareness and stereotypes. Research indicates the primary problem linked to recruiting is lack of student awareness of the field. This lack of awareness combines with a persistent stereotype that clinician jobs are low paying, are dominated by a female workforce, and provide few advancement opportunities (Casina, 2011; Cleophas & Zwinderman, 2010; Hitchcock, 2011; Wellard & Heggen, 2010; Zaleski, 2011). Passiment (2006) noted a number of efforts to recruit more students into the field using professional associations linked to the field were not successful. Cutbacks in CLS training programs could contribute to the shortage of students enrolling in accredited CLS programs.

Cutbacks in training programs. University cutbacks in training programs, as well as hospital cutbacks in medical laboratories, contribute to the recruitment dilemma. A significant problem in attracting students to the field of CLS is that 70% of accredited CLS/MT programs closed between 1992 and 2012, and 65% of programs were eliminated between 1983and 2008, resulting in 50% fewer graduates than previously (Crowley, 2012). News that the programs at Arizona State University and the University of Wisconsin at Madison were closing in 2009 seemed "inconceivable" to Crowley (2012), given the shortages in laboratory workforce in the market. One of the major reasons why fewer students had positive perceptions about CLS was there were fewer medical laboratory-training programs. University programs for medical laboratory professionals has decreased by 50% since the 1970s, meaning even though admissions were up in some programs, the capacity of the program to educate professionals has been reduced (Crowley, 2012).

Program closures were widely considered economic decisions. According to ASCP (2012), vacancy survey data indicated the cost-per-student graduation ratio compared to the cost of the programs in cytotechnology and histotechnology was high, meaning that many colleges deemed the programs too expensive to operate (ASCP, 2012). Only programs that innovated have survived. Effective innovations included providing online education, creating career-entry graduate programs, integrating programs with multiple laboratory specialties or disciplines, and working in a consortium with other programs. For example, the online CLS education program developed by Weber State University in 2001 saved the program by reducing costs, primarily by

teaching students in the clinic and offering all lecture or course material online (NAACLS, 2011).

In California, there were too few accredited educational programs in CLS, with a shortfall of 59% projected in 2010-2020 (NAACLS, 2011). Only 13 programs existed in the state in 2008, and only about 125 students graduated each year. To address CLS shortages, California implemented licensure for MLTs to perform additional testing, but the state still does not allow MLTs to perform more complex testing (NAACLS, 2011). At present, California requires a bachelor's degree plus a year of internship to become a licensed CLS in California. Lack of training sites often makes it difficult for potential CLSs to meet these goals in the specified time (ASCP, 2012).

In response to these problems, ASCP (2012) argued higher education in the field and more clinical sites would sustain public-private partnerships for CLS clinical training and protect regional occupational programs that support some of the training. The state would also have to streamline the licensure process. Overall, Martin concluded that California needed to develop long-term, innovative, and coordinated strategies for addressing the looming allied health workforce shortage, strongly suggesting that token efforts based on increasing student interest would not be enough to reverse a systemic problem based on limited educational capacity.

The arrival of online education also meant that students were able to access courses of study previously unavailable due to distance from an educational provider. The number of online programs increased to allow clinical laboratory workers to continue their education while working at clinical labs (ASCP, 2012). In addition to offering

online programs to alleviate shortages, another approach has been the retraining of laboratory personnel as generalists or cross training them in several areas of laboratory work. A new advanced degree was created, the clinical doctorate in CLS, to help advance knowledge in all areas where clinical laboratory work and patient care interact (NAACLS, 2011). With these efforts are in place to attract and retain qualified professionals, reductions in hospital facilities for CLS professionals will become scarcer.

Reductions in lab facilities. Heavier test loads burden labs. The significant increase of error rates is due to the amount of tests per scientists in the laboratory to perform the tests (Kaplan & Burgess, 2011). Physician legal issues have increased because of ordering of unnecessary tests. It would be difficult to ensure accuracy in testing and a decreased turnaround time with the shortage of laboratory scientists and laboratory facilities that support the physician's offices. The shortage of laboratory scientists and the increased pressure because of cost cutting by health care companies have contributed to a negative perception of laboratory professionals and laboratory facilities making laboratory work less satisfying and more stressful (Kaplan & Burgess, 2011). In addition, opportunities for specialized laboratory scientists to advance are limited.

Specialization and limited opportunities for advancement. Specialization is also greatly complicating the profile of the field and is contributing to shortages in qualified professionals. In terms of the overall challenges in the field, (Medical Laboratory Observer, 2011) found recruitment and retention were becoming more difficult because of the increased competition for staff among laboratories. Automated

technology is quickly changing the way clinical laboratories operate. The fact that laboratory work continues to offer lower compensation than other fields continues to weigh upon recruitment, as does the unwillingness of recruits to relocate, the lack of necessary skills by recruits, and the overall perceptions that the working conditions of clinical laboratories are worse than other fields (Medical Laboratory Observer, 201). At present, most labs struggle to fill positions, and the limited number of students entering into the pipeline to fill positions in the field adds to the problems. Kaplan and Burgess (2011), argued lack of public visibility and limited opportunities for advancement are contributing factors.

Many laboratory professionals also reported feeling underappreciated by hospital administrators and care providers (Kaplan & Burgess, 2011). Lack of opportunities for advancement in the field is another reason for attrition. If, moreover, a professional desired to advance in the scientific or medical aspects of the field, they generally must seek out MD, PA, or Pharm.D. degrees, meaning they must leave the field.

Medical Laboratory Observer (2011) argued, nursing shortages were publicized and society made more efforts that reduced the shortages of nursing personnel. Whereas, the shortages of workforce in the allied health professions, including clinical laboratory work, was “unknown or perceived as less critical, in part because each individual profession has relatively low numbers compared to nursing” (Medical Laboratory Observer, 2011, p. 31). Allied health professions did face as large a challenge as nursing, but experts did not immediately recognize that because the allied health professions as a group encompassed up to 200 different specialties, amounting to a workforce twice the

size as that of nursing. The industry addressed shortage issues of nursing and allied health professions, particularly laboratory scientists, generally because each profession addressed the problem individually. With more baby boomers retiring from laboratory work, as well as becoming part of the aging baby boom generation varied professional options in healthcare needs in the laboratories, will be a greater concern and crisis stage for producing accurate and testing in a specific amount of time (Baker, 2013).

Varied professional options. American Society of Clinical Pathology (2011) noted science graduates had many more opportunities than just lab work, and the 24/7 staffing requirements of such labs and many healthcare fields, "makes these professions a less attractive career option" for many students (p. 1). Spannaus-Martin blamed much of the problem on the lack of visibility of the profession, and this derives from the history of its development as a specialty. While demand rose for laboratory professionals in the 1960s, many programs divorced from hospitals and moved to academic settings, most of the CLS/medical technology training continued to be associated with hospitals. There have been some advantages to this arrangement: having a CLS/MT program at hospitals can assist with filling vacancies from their own graduates (which reduces recruitment costs), tuition money from the programs can assist with salaries, and the close association between the program faculty and the hospital's own clinical laboratory staff also affords overlaps and economies.

By contrast, university-based programs lacked these internal supports; as a result, they cut many of these programs. As these hospital-based undergraduate programs were cut back, master's degree programs that were much more expensive took their place. This

created a cost barrier for students who might have otherwise been interested in the profession American Society of Clinical Pathology (ASCP, 2011). For this reason, many were closing. In hospitals, programs are often closed based on lack of knowledge or understanding of the true costs of CLS/MT, the range of benefits provided by CLS/MT, increased laboratory automation, increased workload, downsizing, misperceptions of staff demands, and the cost of training.

American Society of Clinical Pathology (2011) argued if hospitals performed an in-depth analysis of the role that CLS/MT plays on hospitals closing, it would be fewer hospital CLS/MT program closures. Based on such an analysis, those seeking to keep a CLS/MT open must address high costs, low student enrollment, and the degree to which the work in the laboratory fulfills the overall mission. American Society of Clinical Pathology also focused on the degree to which clinical laboratory programs recruited students and what the industry had to do to improve recruitment. Research has suggested, students usually applied to the clinical laboratory field because influential people had recommended the field and because of their response to the characteristics of the job and the program (Christenbury, 2011).

Among the job characteristics that drew students to the field were its helping nature, its detective nature, and job qualities such as flexibility and security (ASCP, 2011). In terms of program characteristics, program sizes, location, position as a stepping-stone to another healthcare career, and the quality of the faculty were also key determinants. The fact that all programs had clinical rotations was also attractive to most students. In terms of competing with other programs, research indicated students chose a

program because of its reputation, location, the influence of family and friends, the characteristics of the profession, and their response to various information sources, usually involving marketing (ASCP, 2011). Just as, attracting students to the profession are a necessary first step in addressing the personnel shortage; the next challenging step is retaining them to graduation and placing them into professional roles.

Retention Challenges for Allied Health Professions

The significant challenges related to recruitment into the allied health professions also affect the retention in the CLS field. Challenges faced by allied health professionals include increased testing, concerns related to errors and lab safety, increased specialization in the field, and the ongoing demands of technology as it advances (Argaw & Wilson, 2012). It is possible one of the inhibitors to students pursuing and remaining in the medical laboratory profession are reports of infections or disease transmission because of handling or dealing with infectious agents in a laboratory setting Clinical evidence; however, suggests such depictions of medical laboratories might be exaggerated (Argaw & Wilson, 2012). It appears fears of safety may be an inhibiting factor preventing some candidates from entering the field of laboratory science. Promoting the effectiveness of safety standards in the CLS profession would alleviate concerns and reduce the validity of this barrier to career entry (Argaw & Wilson, 2012). In addition, to potentially hazardous work that might make CLS less attractive, the volume of testing that is increasingly expected of CLS professionals may also make recruitment and retention in the field a challenge.

Increased testing. One of the undesirable features of the allied health profession is the significant demand of frequent testing required of practitioners as they develop expertise in the field (Zhi, Ding, Thiesen-Topal, Whelan, & Armaout, 2013). Zhi et al. (2013) indicated doctors increasingly rely on medical laboratory testing. Laboratory use by doctors has increased in recent years due to a number of issues, including facilitated access, the use of auto-analyzers that made giving results easier, and the development of new tests that increasingly involved doctors in more specialties in testing.

Laboratory testing also increased because doctors themselves lack the necessary training in clinical management and because patients themselves, due to the Internet, are more informed about testing and tend to request specific tests more often than in the past. This leads to physicians requesting extra, often inappropriate testing, which "can result in unnecessary discomfort for the patient" (Zhi et al. 2013, p.11). These tests often lead to high a numbers of false positives, which can in turn lead to other referrals that are not necessary, extending the medical diagnosis process indefinitely. For this reason, "the use of the laboratory is a determining factor in the consumption of healthcare resources" (Zhi et al. 2013, p.11). Zhi et al. (2013) estimated that laboratory testing accounted for almost 3% of total healthcare expenditures in Europe, for example. The high degree of inefficacious testing, with 30% of all tests performed within 30 days, has had negative consequences on medical practice. This inappropriate use of testing, combined with ignorance regarding the diagnostic results, has decreased the efficiency and quality of laboratory diagnostic testing.

Zhi et al. (2013) argued efforts must be made to ensure laboratories are not put to inappropriate use, primarily by ensuring that laboratory specialists maintain or be given some control of what testing is done in their laboratories. Zhi et al. also presented a number of strategies to improve the clinical utilization of laboratory tests. The creation of clinical practice guidelines to ensure a more cost effective use of laboratory resources is recommended. Nonetheless, Zhi et al.'s research has shown the implementation of such guidelines is often difficult and that physicians must commit to the process to ensure guideline compliance. At present, most physicians working in various clinical settings did not abide by established guidelines but appeared to work at the disposal of physicians. Zhi et al. also argued quite often, the professional conduct of laboratory testing specialists was not up to standards and that active dissemination of professional standards may be required.

Laboratories must improve their management to change ingrained habits, inappropriate use of tools, demands placed upon laboratories that compromise testing results, and a tolerance of uncertainty in diagnosis, which often resulted in poor testing. The physician's behavior in ordering inappropriate tests is also a need for improvement and change to alleviate an increase in patient testing.

Zhi et al. (2013) recommended physicians be retrained in how they request laboratory tests and the requirements of specific tests may need to be redefined by policy to ensure there is more coordination between testing and diagnostic needs. Specialists in medical laboratories can play a significant role in this reform. Professionals in the laboratory and clinics can support the role of laboratory specialists in clinical councils for

selecting tests and interpreting/using results, improving the use of tests, and remaining relevant in effecting changes in management and organization of the laboratory (Zhi et al. 2013).

Finally, patient behavior also must change to reduce pressure to have unnecessary tests made. Having physicians advise patients against insisting upon certain tests has been found to reduce inappropriate testing by less than 10% (Zhi et al., 2013). Overall, Zhi et al. (2013) proposed a new system be developed whereby the laboratory test is undertaken based on a measurement of the degree to which the test will contribute to an optimal health care model consisting of prevention, diagnosis, follow-up, and treatment. In order for a test to be clinically useful, it must satisfy the conditions of analytical accuracy, precision, reliability, sensitivity, and predictive values.

Sarzotti-Kelsoe et al. (2009) proposed a harmonized interpretation of the four critical elements, including (a) analytical accuracy, (b) precision, (c) reliability, (d) sensitivity, and (e) predictive values and how all four could possibly optimize the management of clinical laboratory operations. They argued training staff to perform the requires periodic audits of clinical laboratories to ensure reliable data and competent competency.

The validation of all methods for safety or endpoint analysis of clinical trials should be undertaken. Proficiency testing that evaluates the data to determine the performance of a laboratory compared to others is required annually. Increased testing was, in part, a result of technological improvements. So too, technology exerts influence on the field in other ways as well.

Technology. Technology has evolved more in laboratories causing the skills of technicians to change requiring more highly skilled technicians, and in many other ways further expanding the skill set of trained laboratory scientist. The development of state of the art technology at most laboratories can alleviate some of the operational difficulties associated with clinician shortages. The staff of the Medical Laboratory Observer (2011) argued automation could greatly improve the capacity and resultant quality of medical laboratories, and make up for the shortage of skilled professionals.

Technology has helped medical laboratories meet their workload and quality demands with more regularity, increasing morale among clinical professionals as well. The staff of the Medical Laboratory Observer (2011) posited that increased automation could help medical laboratories meet the increased demand for testing. While some observers feared that automation would reduce staff, automation has freed laboratory scientists and technicians to defer routine tasks to technology and address new, more-challenging problems and services.

While new technology makes it necessary for laboratory technicians to receive continuing education, it is also true that technology alleviates the routine nature of their work, as well as pressures resulting from heavy workloads. According to Kimball and Resneck (2008), some argue the shortage of allied health professions in the workforce would have to learn the scientific theory underlying new technology and to know how to best leverage skills for improving the workforce shortages in healthcare. Only by understanding the science behind the instrumentation will laboratories be able to maximize the use of the instrument's effectiveness. For students of medical laboratory

work to gain experience with technology, it will be necessary for schools to procure examples of equipment through programs like the instrument donation program operated by Labs are Vital (Kimball & Resneck, 2008).

Technological advances have also influenced the clinical medical laboratory field in positive and negative ways. Casina (2011) argued laboratories are under constant pressure to do more with less, including fewer skilled workers and scarcer financial resources. In the laboratory, technology usually stepped in and resolved problems caused by shortages of personnel in both clinical and educational sectors. In the twenty-first century, the additional recruitment of technologists has declined, but the increase of technology in the laboratories may eliminate labor-intensive, time-consuming manual testing (Casina, 2011). Casina suggested a scenario whereby in the future, medical laboratories in key specialties may be able to operate with fewer technicians aided by advanced technologies, which ensures safety and reliability of results. Awareness of advanced technologies in laboratories may also act as an inhibiting factor on clinicians thinking of entering a field they assume to be in jeopardy due to technology advances.

Zaleski (2011) argued technology could be one of the solutions to the workforce shortage problem in medical laboratories. Zaleski described the case of a medical laboratory connected to a hospital in Iowa that reduced its pre-analytic processing time by using LEAN production principles combined with technology to eliminate waste and maximize value. This meant the pre-analytic phase of going LEAN in the laboratory processes was to reduce the steps and allowed samples to move through accessioning, centrifugation, and aliquoting processes more easily. A pre-analytical instrument

established a “sample superhighway” that reduced TAT in most testing by over a third (Zaleski, 2013). The automation of the process also allowed for the management of volume with fewer hours worked, an increase in volume by 20% accompanied by a decrease in working hours by 9% (Zaleski, 2013). Thus, technology improved both the processing of tests and the involvement of staff in the laboratory. However, there is a danger that some this automation would seem to create a quantitative climate where less skilled workers are all that is required, possibly driving candidates away from the profession (Zaleski, 2011).

Louis, Virgin, and Asa (2011) focused on both the change in paradigm and increased technology as forces changing clinical laboratory environments. Genomic invention promised the development of personalized medicine over the next generation; clinical laboratories will play an increased role in patient management as this develops. Informatics has allowed for the gathering of diagnostic data in data warehouses that professionals routinely mine for diagnostic and policy decisions. Louis et al. (2011) argued, “The application of informatics and computational biology and its integration with hospital clinical systems may alter how we make diagnoses” (p. 1531). Technology advancements are positively affecting the laboratory environment for new generational clinical laboratory scientists.

The major impact of technology and genomics on the diagnostic laboratory was that the new technology blurred the traditional distinction between clinical and anatomic pathology, and in the not-too-distant future, a complete genomic laboratory to generate lower costs. The complexity of biomedical information, as well as the need for improving

performance and efficiency, suggests the model of a single pathologist in charge of a hospital laboratory would be replaced by sub specializations in which healthcare teams work with physicians and others to determine diagnoses (Louis et al., 2011). This sub specialization model creates new opportunities in the field, but it also creates new demands for the workforce as many clinical positions go unfilled. The wider range of possibilities may attract individuals to the field who may not have otherwise considered it, but the industry needs to market and introduce these opportunities to students early.

While acknowledging that technological advances in the field would strike some as exciting, it is also true that the prospect of entering a field experiencing rapid change may appear daunting. Indeed, Richmond (2009) noted all stakeholders involved in medical laboratory work must be committed to lifelong learning to keep abreast of change. Given the fact that in the healthcare field, technology and treatment protocols can change daily, this might seem overwhelming to the student looking ahead at the field (Richmond, 2009). Therefore, it is important to educate students about careers in CLS to resolve the personnel crisis of laboratory scientists.

Educating Students about Careers in CLS

If the allied health professions were to resolve their personnel crises and recruit qualified and dedicated professionals, it would be necessary to develop recruitment strategies that speak to college-preparatory audiences interested in the health sciences. Clinical life science programs are in a good position to educate students about their career options in the allied health professions. Marketing CLS opportunities to youth may be a key solution to addressing the recruitment challenges facing the field, but researchers do

not understand much about what attracts young people into such fields (Massiha, 2011). This section of the lit review highlights successful programs that offer foundational insights into marketing models that can support student interest in allied health.

A noted example of a successful CLS program is the University of Texas-Pan American, which found success by having the faculty teach clinical microbiology to nursing and other students and provided medical terminology training for all medical students (Zhi et al., 2013). Universities have also found that providing multiple career entry programs can offer specialty training under a common CLS umbrella, reducing costs (Zhi et al., 2013). In order to address the shortage of histotechnologists and keep programs training them open, a number of institutions have combined cyto- and histo-technology education.

The success of any program relies upon its ability to mirror the expectations of the field and to prepare successfully students for entry into it. The problem is urgent; in 2005, there were only 4,390 CLS/CLT graduates to meet a demand of 60,000 CLS/CLT personnel (McClure, 2009). Barriers to entry into the field include too few educational programs, limited educational capacity of the programs that exist, faculty shortages, too few training sites, few rural programs, limited distance learning programs, and lack of visibility and awareness of allied fields by students. These are the challenges that allied health educators must address, in the same way as promoting awareness of the profession.

Promoting awareness of the profession. McClure (2009) surveyed junior-senior level college biology and CLT/CLS students to gather their impressions of CLS/CLT

professions and the factors they found both attractive and unattractive about the field. Factors appealing included the variety of work environments in laboratories; the knowledge students could gain from such work, the fact that laboratory work is hands-on work, and that it was healthcare-related but with little patient contact. The work of Doran (2009) corroborated these factors.

Most students understood that CLS/CLTs were essential members of healthcare teams, and all expected if they studied in the field, they would have little problem getting a job upon graduation. Other aspects of the job important to students were flexible work hours, advancement opportunity, and being part of a healthcare team.

At the same time, 75% of students reported the field did not provide CLTs with sufficient advancement opportunities, though college biology students were more optimistic about these opportunities, perhaps because they better understood the shape of the discipline (McClure, 2009).

With regard to overall impressions of the field, students reported it was a career very few people knew existed and even fewer had knowledge about the duties and responsibilities of CLS/CLT employees. The CLS/CLT personnel received little respect or support from nurses and physicians. The laboratory personnel also had positions underutilized by laboratory management, the salary was not commensurate with the knowledge required to perform optimally on the job, and many older-generation /technicians seemed frustrated. Thus, in terms of overall impression, most students reported the negative aspects of the job, all of which combined to create a barrier to interest in the field. When asked about employment, 85% of students said it was

important for them to love their work, and whether or not they could do this given the problems they associated with CLS/CLT was an issue (McClure, 2009).

Students identified their teachers, high school advisors, and representatives from CLS/CLT programs as stakeholders who most influenced them to choose a career, followed by independent internet searches (McClure, 2009). They rarely mentioned college advisors as contributing to their interest in the field. Students also recommended recruiters be more forthcoming with visuals to demonstrate all of the various technical wonders that laboratories contained as a tool to attract more students. Most students also stated the presence of program directors at high school and job fairs would be the most important and helpful way for CLT to increase its visibility among students (McClure, 2009).

When asked about methods that could attract more students into the CLS/CLT field, most students felt that grant funding, scholarships, and loan forgiveness programs would help; a grant program was attractive to 85% of respondents (McClure, 2009). The fact there was limited advancement opportunities in the field emerged as the leading factor inhibiting student entry into the field (McClure, 2009). Based on these results, McClure stressed the need to develop suitable career paths in the CLS profession so that students can advance to positions that will fully utilize their education. Employers must develop a career ladder for CLS/CLT students that provide a way for salaries to increase across the course of a career. Solving this problem will not only improve recruitment to the profession, but also support the awareness of communication of the laboratory profession (McClure, 2009).

Doran (2009) studied the attitudes and perceptions of community college and university science students and found results similar to those of McClure (2009). Topics discussed included career preparedness, job opportunities, anticipated salary, and laboratory science employment. Most students turned away from a career in medicine thinking that it is only involved directly with patients, unaware of allied health fields through which they can indirectly support healthcare.

Doran (2009) noted a continuing stereotype that lab work is a technical position with low prestige and that lab work is an exclusively feminine line of work. Though the workforce is comprised of 79% women, men tend to hold more supervisory positions. The fact that community colleges often offer the medical technician degree tends to reinforce the stereotype that lab work was a vocation, as opposed to a profession. Doran hypothesized while many college science students might well be candidates for the profession, many failed to enter the profession simply because they were unaware of it. This supposition of unawareness among students proved to be true, as few students reported knowing much about the profession, its requirements, or the opportunities it offered them. This lack of awareness is likely because most students pursuing science never experienced the scientific techniques involving slide production in laboratories in their coursework or learned how lab work connected to patient care.

To address these problems, Doran (2009) recommended an evaluation of ways in which the science curriculum can improve student awareness of the field, strategies for guidance counselors to promote allied health, and the creation of promotional literature for the field be distributed in science classes. Doran also recommended that college

counselors and representatives from laboratories develop a working relationship with each other and with the science departments to create awareness of a career pipeline from the classroom to the laboratory. Laboratory tours, guest speakers, summer science career programs for high school students, annual open houses at labs, and one-day science programs such as those sponsored by the Women in Science and Engineering and the creation of career websites are important methods to attract more students in to the field (Doran, 2009). Integrated marketing, which is a non-traditional approach to marketing science programs, is an effective strategy for promoting awareness to students of the field. In fact, integrated learning programs in laboratory science at high schools can also support student interest in the field by assisting students in making connections across the science curricula.

Developing integrated learning programs. Allan, O'Neara, Pope, Higgs, and Kent (2011) argued more integrated training for students with a potential interest in laboratory work would facilitate entry into the field and that university-run clinics would be a way to do this. Traditional apprenticeship models, where students learn from an experienced practitioner in the context of a real-world workplace, have become difficult to sustain primarily due to workforce shortages and funding constraints, yet they remain effective settings. Allan et al. (2011) noted clinic environments provided realistic experiences, including not only practice but also communication with patients and colleagues and learning about all aspects of clinic operation.

Despite the advantages, integrated learning brings challenges in collaboration between the clinical setting and the university with regard to curriculum and in assuring

that learning objectives can be met within the setting. Officials must carefully manage these challenges if integrated learning is to be successful. When well managed, Allan et al. (2011) posited this type of learning environment could support student commitment to the field. Overall, problem-based learning and mentoring are two proven methods to support student commitment (Allan et al., 2011).

Problem-based learning. Problem-based learning (PBL) has become the foundation of medical education since Harvard medical school adopted this approach in 1985 (Allen et al., 2011). In PBL, students, in addition to listening to lectures, spend time in the lab in self-study modules to identify diseases and infections. Block schedules, small groups, spaced repetition, and active learning characterize the curriculum. Cooke et al. (2012), argued the new curriculum is successful insofar as "students arrive on the wards with an organized approach for analyzing their patients' problems and an ability to selectively draw on, interpreted and applied information from the vast reservoir of material covered in the pre-clerkship years" (p. 14). The integration of basic sciences and clinical education would also counteract the tendency of traditional medical education to sideline laboratory work to a supported function would and resituate it at the center of medical practice.

Waight et al. (2011) likewise addressed the problem that basic science and clinical practice remain separated in pre-clinical medical education, offering future physicians little opportunity to apply their knowledge in practice. Therefore, they recommended hands-on laboratory exercises to counteract this division. This kind of fusion "heightens students' awareness of the relationships between basic science and

clinical practice" (Cooke et al., 2012, p. 15). Besides, providing students with PBL opportunities to promote learning, research suggests integrating mentoring programs into students enrolled in scientific theory and laboratory practice courses is also of importance in college.

Mentoring. With regard to the teaching needed to fulfill the employment requirements of the field, Aronson (2010) also outlined the requirements of teaching, mentoring, and the creation of texts as well as sponsoring, protecting, and promoting younger practitioners entering the field. Without mentoring, Aronson did not see how a young person interested in a field like clinical pharmacology could advance to a level of practice that fulfills the scope of a systems-based operational model of the field (Aronson, 2010).

Moreover, mentors support the personal development, the career advancement, the choice of specialty, and the ultimate productivity of the mentee. In the same way, if a person chooses to remain at the research level, "There are also no boundaries to the types of clinical research that they … can undertake, since their interests span all medical specialties in which drug therapy is involved" (Aronson, 2010, p. 13). In this way, clinical researchers will necessarily have to collaborate with researchers in a number of other fields. Therefore, clinical life science professionals must advocate broadly for one another and for the profession as a whole.

Advocating broadly for the profession. It is possible that medical laboratory work requires a manifesto to clarify to all stakeholders, especially students, what the profession entails and the various areas of medicine to which it is connected. Aronson

(2010) endorsed such a program for clinical pharmacology to clarify the scope of the discipline and the areas of study encompassed by the specialty. Aronson defined a *manifesto* as a public declaration or proclamation that propounds a theory or argument, that will make educators and students aware of the profession.

Aronson's (2010) manifesto included a definition of clinical pharmacology, in tensional, extensional, and operational definitions of the practice; a description of what clinical pharmacologists to do; and a model of how expertise in clinical pharmacology is disseminated, though he leaves out how a clinical pharmacologist should be trained. Most importantly, the specialty is of focus: area of practice and various locales where the specialty exists, ranging from hospitals to private companies (Aronson, 2010).

Kibak (2008) found that lack of public awareness of the role that medical laboratory clinicians play in medicine was a major deterrent to recruiting a new workforce. Even healthcare professionals often view the "lab" as a mechanical site and not a place staffed by trained scientists. The Health Indicators Five campaign began in 1999 by the AACC to raise general public awareness of the role of clinical laboratory workers in fighting five major health issues, ranging from diabetes to prostate cancer (Kibak, 2008). Next came Lab Tests Online, which demonstrated to the public and students a broad range of laboratory tests, attracting 80,000 visitors in its first month online in 2001. The lab test online site continued to have 1.2 million visitors per month, with 75% of the visitors being members of the general public and others being laboratory scientists (Kibak, 2008).

To promote student awareness of the role of laboratorians in healthcare, the Coordinating Council on the Clinical Laboratory Workforce created recruitment and retention materials to alert them to career opportunities in the field (Kibak, 2008). Founded by Abbott Laboratories, "The Labs Are Vital" recruitment effort reached into high school and middle schools to highlight the critical role that lab professionals play in healthcare. Siemens and other corporations have also created scholarship programs for students in CLS and CLT programs (Kibak, 2008).

Some additional programs could also include, The ACLA's Results for Life program, begun in 2006, illustrates the value of laboratory testing to policymakers, while the AdvaMed Progress You Can See program improves general understanding of medical technology (Kibak, 2008). To improve awareness of the role of the laboratory in the profession, some institutions now include visits to laboratories as part of the grand rounds given to medical students in training hospitals. The goal of this project was to make use of the physician as a go-between to the public to increase general awareness of the role played by the clinical lab professional in their health.

Another drive to increase the visibility of labs was to encourage direct contact between lab professionals and the public by placing clinical labs on medical floors or linked to ICU units (Kibak, 2008). A number of labs now have clinical lab scientists answer phones to communicate directly with doctors or the public. In this and in curricula in medical school, the clinical lab scientist was slowly being repositioned as a liaison and consultant who communicated with various stakeholders involved in the healthcare process (Kibak, 2008).

Stanford (2012) also argued recruitment for the medical laboratory profession must go beyond science festivals, honorary weeks, and student tours of laboratories. Greater visibility within the healthcare system itself is likely a more productive approach to improving public awareness of the profession that will then affect student perception of the profession. Stanford commented "we as laboratorians are usually content with the behind the scenes stereotype, preferring the anonymity inherent to our profession" (p. 1), and this stance has contributed to the fact that students know nothing about the profession. Thus, Stanford (2012) recommended reaching out to the hospital's staff so they are well informed about what exactly the clinical laboratory does in the process of caring for a patient (Stanford, 2012).

Plebani and Lippi (2010) argued most students turn away from clinical practice and research when they are overburdened with theory-based academics. Students who are science majors, such as biology and other clinical or lab-based fields, learn of the stress of academics by collaborating with other students enrolled in similar programs. According to Plebani and Lippi (2010), diminished enrollment in programs results in clinical shortages due in large part to a lack of promoting careers, compensation, and laboratory activity. Rather than hearing of the attractive qualities of these fields, the students may hear others speaking of the difficulties of theory-based academic courses in the programs. Plebani and Lippi (2010) argued attracting more students to skilled laboratory work could be accomplished by letting students focus on a career in laboratory science rather than the more academic or theoretical programs.

Price (2010), in a similar fashion, argued the field must protect the definition of laboratory medicine. Laboratory medicine is rooted in observation, the experimental method, biomarkers, analytical technology innovation, and communication. Translating laboratory data into practice remains a challenge because of the need to (a) prove effectiveness of treatments, (b) keep knowledge up to date, (c) incorporate innovations in practice, and (d) work as a part of a multidisciplinary team. In this way, Price argued laboratory medicine would maintain its structure and stature as a discipline in medicine and resist being commoditized into mere testing.

Clarifying possible career paths from medical laboratory science also serves to provide students with a fuller sense of why they might want to enter the profession. Some interventions have presented results that indicated an improvement in program enrollment because of recruitment and retention efforts (Baker, 2013; Hogan & Matheson, 2010). Hogan and Matheson (2010) described a program by the Indiana State Department of Health that involved hosting high school students and college students on tours of state health laboratories. In addition to the tour, students received take-home materials highlighting science websites and possibilities for summer science lab internships.

For college students, students who expressed interest in the field visited the lab to learn about the skills and qualities sought after by laboratories. In both cases, accessing students through science teachers was part of a larger state effort to attract more students to the field. Virtual tours of the state labs also aimed to attract more students to the field (Hogan & Matheson, 2010). Hogan and Matheson (2010) suggested tours attract more science students from target high schools and colleges to the clinical laboratory field.

Similarly, Baker (2013) described the Health Careers Camp created by Ferris State University in rural Michigan and co-sponsored by the Regional Skills Alliance, an organization consisting of healthcare employers, the state employment agency, and area educational institutions. Targeted at high school students, the goal of the camp was to increase student awareness of an interest in careers in clinical laboratory work. Activities involved teams exploring various medical-technology services, including practical activities such as blood banks, hematology, and immunology.

The participants in the Ferris program reported a higher degree of interest in hands-on activities ranging from separating plasma from red blood cells to performing an antibody screen to setting up a metabolic profile (Baker, 2013). An interactive simulation of a real-life emergency was the climax event of the week, in which students participated in the activities required by medical laboratory personnel in the case of a toxic material spill. Students served as mock health professionals to conduct all the services necessary to care for patients resulting from the staged accident. In post-camp interviews, students reported being impressed with the level of detail in clinical laboratory work and with the wide scope of laboratory testing. Because of participation in the camp, quite a few participants expressed an interest in learning more about the field and were positive about their overall experience (Baker, 2013). More importantly to Baker (2013), students also acknowledged the separate existence of the profession of CLS as opposed to nursing or being a doctor.

Conclusion

This review of the literature was developed to explore the major reasons students were not attracted to careers in medical laboratory science, resulting in a chronic shortage in this key allied health field (Zaleski, 2011). Research indicates the primary reason why students were not entering the field was they were unaware of the field and that this lack of awareness likely resulted from stereotypes developed over generations that the profession is a low-paid technical vocation primarily employing women with little opportunity for advancement and little contribution to patient care (Wellard & Heggen, 2010). For this reason, research on recruitment suggests ways in which laboratories can attract more students by using marketing devices (Carden & Zappala, 2009).

Perhaps the most germane long-term solutions to the problem of the field were rooted in the very definition and structure of the medical laboratory field (Casina, 2011; Cleophas & Zwinderman, 2010; Hitchcock, 2011; Wellard & Heggen, 2010; Zaleski, 2011). If the field integrates better with medicine, clinical laboratory workers will have more direct contact with all healthcare staff. CLS professionals will be able to work as team members with others, climb up career ladders, advancement possibilities in the profession, and develop a more expert consultancy role in the healthcare field (Aronson, 2010; Campbell & LaCost, 2009; Chung & Behan, 2010; Doran, 2009; Kibak, 2008, Marks, 2011; Martin, 2009; McClure, 2009; Plebani & Lippi, 2010; Price, 2010; Stanford, 2012). Thus, while marketing efforts are important for the recruitment of students in medical laboratory science, it would appear that restructuring the field to

conform to the demands of twenty-first-century medicine is the ultimate solution to recruitment problems (Hogan & Matheson, 2010).

Implications

The researcher designed this project study to support the identification of strategies that will provide high school and college student's knowledge pertaining to the CLS profession and career opportunities available as laboratory scientists. Communicating information regarding the profession to learners will increase awareness about the variety of allied health professions available. Accordingly, communication may encourage students to enroll in a degree related to the field when enrolling in a college or university or even to enroll in a hospital affiliated CLS program. In addition, increased enrollment in courses to create greater demand for programs may lead to an increase of accredited programs available.

Summary

Section 1 included an introduction to the problem that became the focus of this project study. In review of the literature, I presented arguments for the use of Bandura (2001), social learning theory to support the study. It is evident the current and future shortage of laboratory scientists will affect the care and treatment of patients. The results indicated the development of the project's focus was on educating the high school science teachers of the CLS profession and the incorporation of the CLS profession into the high school science curriculum. The researcher focused on the awareness of the CLS profession and how lack of awareness directly affects the shortage of students enrolling in a CLS program and remaining in the profession. Further, the researcher developed the

study to explore how aware laboratory scientists were of factors and how they viewed potential consequences that emerged from the drastic shortage due to accredited programs closing, lack of communication of the profession to high school students, and the retiring of laboratory scientists.

The changes of the Clinical Laboratory Science (CLS) profession in the 21st century will continue to develop to ensure there are adequate and sufficient laboratory scientists performing tests. There are learning initiatives in the advancement of CLS. Colleges and universities are developing learning programs and problem based learning to assist students interested in enrolling in CLS. Besides learning programs being developed for CLS students, there are also mentoring programs that assist students in CLS with assistance from others in the profession. Mentorship and learning programs will possibly increase the awareness and enrollment of CLS students in accredited programs in the future.

The next section of this project study will concentrate on the qualitative research design used to investigate the relationships that exist between the lack of awareness and communication of the clinical laboratory scientist's profession in the new generation. In qualitative research, the researcher does not really know where the research will lead. The researcher chose phenomenology research method for the project study. The methodology section will also focus on the research design and approach, rationale for chosen design, and human rights protection of participants.

Section 2: The Methodology

I explored high school students' understanding and perceptions of allied health professions, factors that contributed to college students' enrollment in CLS-related programs and CLS professionals selecting CLS as a profession, and the anticipated consequences. I used a qualitative approach with a phenomenological research design. The phenomenological design was used to explore the lived experiences of participants to illuminate the dimensions of the phenomenon under study; rather than starting from perceptions and hypotheses, phenomenological researchers gather data and identify themes to answer their research questions (Creswell, 2012).

This chapter includes the procedures I used to conduct the phenomenological study. I provide a description of the qualitative research design, qualitative tool of analysis, type of coding, type of analysis, participants, and rationale for the design chosen. I also justify the participant selection process, describe measures for ethical protection of participants, and present the data collection process, role of the researcher, and the proposed data analysis. This chapter concludes with a summary of the research methodology.

Philosophical Framework

Establishing a philosophical framework allowed me to work with tools and methods within that framework to formulate the research questions for the study (Glesne, 2011). The information enabled me to focus on emerging themes and patterns that assisted with answering the research questions (Glesne, 2011). I used a phenomenological design to focus on the "lived experiences and the way we understand

those experiences to develop a worldview. The phenomenological approach rests on the assumption that there is a structure and essence to shared experiences that can be narrated" (Marshall & Rossman, 2011, p. 148). Phenomenology is one of four "paradigms or worldviews" in which participants establish a "set of beliefs that guide action" (Creswell, 2012, p. 17). Phenomenological researchers aim to gather rich data from participants to answer the research questions.

By using a qualitative phenomenological approach, I was able to construct a descriptive, inductive narrative based on participants' knowledge of the phenomenon and their lived experiences related to the study. This approach allowed me to develop a better understanding of what participants believe and experience, and to explain in detail how the shortage of CLS professionals in the new generation will affect the laboratory profession and society. According to Spaulding and Voegtle (2010), a qualitative research approach is used to collect data through observations, interviews, questionnaires, and findings summarized through verbal means or a narrative. By using a phenomenological approach, researchers can ask participants specific questions grounded in a philosophical tradition, focus on the participant's concept or phenomenon of interest, and highlight the individual's essential experience with the phenomenon (Glesne, 2011). Gaining information from the participants' personal experiences assisted me in determining the contributing factors that caused the shortage of CLS professionals in the 21st century.

Restatement of the Research Problem

The increase in baby boomers retiring from the CLS profession will cause a significant shortage of laboratory scientists in the profession (Flores, 2010). In this project study, I examined the factors that relate to a lack of awareness and communication about the CLS profession and how they relate to the cause of the excessive shortage of students enrolling and staying in the profession. The populations of students affected by the drastic shortage of laboratory scientists are the next generation of learners, including high school and college students. Many of the students enrolling in colleges are not aware of the various medical programs in allied health and the career opportunities they provide (Flores, 2010). With many laboratory scientists retiring, an implementation of a CLS program at community hospitals would assist with preventing the shortage of laboratory scientists in the future.

Kaplan and Burgess (2011) suggested younger students are not interested in laboratory medicine as a profession because of the profession's lack of enticement and recognition. Community education is valuable in that it allows students to explore allied health careers and helps them identify a health profession of interest (Sasnett et al., 2010). Laboratory scientists and educators consider the program as invisible to many students because of a lack of knowledge that the program exists and lack of awareness of career opportunities available.

Research Questions

The phenomenological study addressed the issue of the shortage of CLS by allowing participants to describe their lived experiences as students and laboratory professionals. The research questions that guided this study included:

RQ1: What are high school students' understanding and perception of the allied health profession?

RQ2: What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program?

RQ3: What are the factors that influence CLS professionals' awareness and pursuit of the profession and what factors relate to their longevity in the profession?

Research Design and Approach

Qualitative researchers are concerned primarily with exploring meaning in how people make sense of their lives, experiences, and structures of the world through conversation (Lodico et al., 2010). One way to collect data is through a qualitative approach, which can include ethnographic, exploratory, case study, and grounded theory research designs. Another way to collect data is through a quantitative approach, which involves analysis of numerical data. Complex, content-centered analysis is required in qualitative research to recognize and understand patterns, relationships, and conditional ties that affect the interpretation of findings in a study (Bamberger, Rugh, & Mabry, 2012). Recognizing a shortage of laboratory professionals exists will increase the need for research addressing the lack of awareness of the profession among elementary, high school, and college students. Phenomenological research allows the researcher to elicit

participants' stories of their experiences and analyze them in an effort to understand the experiences or phenomenon better (Denzin & Lincoln, 2011).

The data-collection strategies used in this study included in-depth, semi structured, face-to-face interviews, focus-group interviews, questionnaires, and life histories or narrative inquiries of high school and college students (Lodico et al., 2010). Data analysis for the phenomenological qualitative method includes an inductive, descriptive approach to describe an experience as it is actually lived by the participants. The purpose of examining the narrative inquiries from participants was to understand and research the way people create meaning of their lives (Rubin & Rubin, 2012).

I used thematic analysis to identify common themes and subthemes to answer the research questions. The phenomenological data analysis involved open coding to categorize and make sense of the essential meanings of the phenomenon. During open coding, the data was categorized and reduced to a small set of themes that describe the phenomenon under investigation (Chun, Fung, & Chien, 2013). I used Atlas.ti, a qualitative data analysis tool, for intuitive open coding and linkages to identify themes in the study. I followed this complex analysis by extracting narrative data from interconnectedness and commonalities of systemic categories to develop meaningful conclusions. Kaner and Fiedler (2013) noted Atlas.ti could be used to uncover the complex phenomenon hidden in data and keep the focus centered on the material. Data gathered from the interviews provided a rich description of the experiences of students and laboratory scientists and indicated how they became aware of laboratory science as a career and their perceptions of the profession. I analyzed themes based on recurring

points made by participants. Samples from the data were used to illustrate the themes reflecting participants' viewpoints.

Rationale for Research Design

Researchers have several qualitative research methods from which to choose. I used a phenomenological design because it allowed me to "study things as they are perceived, without regard for whether they are objectively real, to understand people's perceptions and experiences and the meanings they give to events and concepts" (Bamberger et al., 2012, p. 289). I did not use an ethnographic design because I was not interested in investigating an intact cultural or social group (Hancock & Algozzine, 2011). Grounded research design focuses on building theory from literacy analysis (Creswell, 2012), which was not appropriate for this study.

I did not employ a quantitative approach because my purpose was to construct an inductive description of the phenomenon as described by the participants in the study. Quantitative designs are needed if the researcher needs to identify sets of variables and determine their relationships using statistical analysis (Creswell, 2012). Qualitative studies are preferred when "contributing to a greater understanding of perceptions, attitudes, and processes" (Glesne, 2011, p. 39). A qualitative researcher seeks to discover participants' stories of their experiences and put them together in an effort to understand the experience or phenomenon better.

Participants

Once a researcher decides on the purpose of the study, research questions, and research design, the next step is to select participants and sources of data (Lodico et al.,

2010). I collected data from college or university students enrolled in an accredited CLS program. The second focus group consisted of high school students who provided data on their perceptions of CLS professionals and factors that motivate or diminish their interest in the profession. The data yielded insights on possible reasons for the shortage of CLS professionals and the reduction of enrollment and retention in CLS programs. The third group of participants chosen for the individual interviews consisted of experienced CLS personnel and CLS educators. I conducted individual interviews to collect data on the factors that may be influencing the scarcity of laboratory scientists and educators in the 21st century.

I used a purposeful sampling technique to identify participants who had experiences that related to the phenomenon under studied (Creswell, 2012). In addition to the purposeful sampling technique, I also chose maximum variation sampling to develop diverse perspectives to answer the research questions. Maximal variation is a purposeful sampling strategy in which the researcher samples individuals who differ on some characteristic or trait (Creswell, 2012).

An example of a characteristic or trait I was interested in exploring in the study were the factors that cause lack of awareness of the CLS profession and the perceptions of students that motivate or prevent them from pursuing the profession. The use of the phenomenological design allowed me to "gain an understanding about a known phenomenon at the individual level" (Clark, 2005, p. 5). A qualitative researcher seeks to elicit participants' stories of their experiences and analyze them in an effort to understand the experiences or phenomenon better.

Participants

Three separate groups of participants were included: five high school students, five college students, and seven experienced CLS professionals. I sent selected participants a formal letter soliciting their participation in the study, and to provide information about the study, including risks of participating and a description of the CLS profession (Appendix E). I examined several populations to gain a holistic view of the topic under study. The rationale for sample size for each group was based on previous phenomenological studies done to examine allied health problems (Clark, 2005). I chose all participants based on specific inclusion and exclusion criteria.

Inclusion and exclusion criteria. Students enrolled in high school were eligible to be included in the first group of the study. The high school students who participated included in the study were not enrolled in science classes; they were random high school students enrolled at the participating high school who met the inclusion criteria. The only criterion for high school students was that they were 18 years or older. I excluded high school-age students who were not enrolled in school or who were younger than 18 years due to restrictions in obtaining parental consent. The second group included college students enrolled in a CLS program. The third group consisted of experienced laboratory scientists of any age or gender. I excluded individuals no longer working as a CLS.

Selection and sample. I chose high school students to acquire information about their understanding and perceptions of the allied health professions. I obtained high school participants through Thornton Fractional High School North's administration using a request for participation letter. School administrators helped identify a pool of

eligible students. I made explicitly clear to school administrators prior to their identification of potential participants that only students who had already turned 18 were eligible to take part in the study. This age requirement prevented the potential of interacting with minors for whom parental consent to research may not be available. Eligible participants received informed consent forms to read, review, and reply by e-mail if they were willing to take part in the study. Five participants out of the seven who volunteered attended the focus-group session, so I did not turn away any participants or choose them using random selection.

I selected college students already enrolled in the CLS program as participants to obtain their insights on how they became aware of and attracted to the program. I recruited college student participants through the help of a professor and university administrators with CLS students and a program director at university and hospital with students already enrolled in the CLS program (see Appendix D) using a request for participation letter. Similar to the high school sample, college students identified as eligible received informed consent forms.

I selected the sample of CLS professionals for the study to identify the factors that attracted them to the profession and reasons related to their longevity in the profession. I chose participants from this sample through coordination with a hospital laboratory director and hospital vice president. These individuals helped to identify potential participants and provide access for me to present them with information about the study and consent forms.

Participants identified based on their familiarity with the central topic and lived experiences make the best sample for phenomenological research studies (Carpenter, 2010). Seventeen participants were included in the sample for the study. The sample included five college students, five senior high school students, and seven CLS professionals. The sample chosen for the study was to gain information on a variety of individuals' experiences and their experiences in educating future laboratory-science students at an accredited CLS program at a community hospital.

In qualitative research, the selected sample size is normally small to allow for in-depth analysis of data, unlike quantitative research methodology, which requires a larger number of participants in the sample for statistical analysis (Butler, 2011). In regards to interpretative phenomenological analysis specifically, Smith and Osborn (2015) stated "There is no right answer to the question of the sample size and depending on several factors: the degree of commitment to the case study level of analysis and reporting, the richness of the individual cases, and the constraints one is operating under" (p. 56). They further stated researchers recommended five or six in the recent past as a "reasonable sample size for a student project using Interpretative Phenomenological Analysis IPA" (Smith & Osborn, 2015, pp. 56-57). The sample included both females and males. I selected a critical sampling because it enabled me to sample participants purposefully in a group with defining characteristics and in-depth knowledge and because the individuals represent the central phenomenon in question to generate a theory or concept (Creswell, 2012).

Sampling methodology. Typical, unique, maximum variation, convenience, snowball, and network are some of the various types of purposeful sampling. I used a convenient purposeful sampling technique with the use of maximal variation strategies for sampling participants from the population. Convenience sampling entails including persons readily available for study in the research sample. Merriam (2010) asserted it was beneficial to use this type of sampling technique due to restrictions of time, money, location, and availability of sites or respondents.

Exploratory research regularly uses convenience sampling to collect data generally representative of the population of interest. Researchers commonly use this approach during preliminary "research efforts to get a gross estimate of results, without incurring the cost or time required in selecting a random sample" (Grundy & Miesch, 2013, p. 30). Through this sampling method, I was able to collect data within a certain period and under more facilitating conditions. By its nature, convenience sampling sacrifices generalizability and therefore a convenience sample may not sufficiently represent the target population. Thus, those individuals selected for the study may only partially represent the population under study, and replication may be necessary to validate results (Vik, 2013). Despite its deficiencies, convenience sampling was the best method for obtaining a sample population when conditions such as time and funding prohibit random sampling. This methodology enabled me to seek an approximation of the truth when seeking the truth regarding the answers to research questions (Bryman, 2012).

Protection of Human Rights and Access to Participants

The study of human subjects adheres to the Institutional Review Board's (IRB), including ethical standards and research processes to protect individuals who participate in a study. I gained access to the participants after getting approval from Walden University's Institutional Review Board, IRB approval number 12-04-13-0172253 (Appendix B). According to Creswell (2012), the IRB strives for excellence in human research participant protection, as well as to exceed customer expectations in regulatory and legal requirements.

Ethical guidelines were included in the letter of cooperation and in the consent form participants received prior to the focus group, interview, or any data collection tool. It also explained related risks and benefits to participating in the qualitative research study, as well as the fact that participation was voluntary and participants had the option to leave without consequence at any point during the study. Rights and access to participants were successful during the data collection. There were no conflicts of interest for anyone participating in the study. I did not receive payment to conduct the research, and participants did not receive payment to take part. The participants also did not receive any benefit or consequence from choosing to take part, or not take part in the research. Only participants who were employees in the main laboratory of the community hospital, and students whom I was not teaching were included.

My certification of completion for Human Participant Protections is in Appendix B. The participants had the right to confidentiality. I assigned each participant a pseudonym in the focus group to support confidentiality. With adequate human

protections in place, I contacted potential participants following IRB approval from Walden University. Collection of data from the community hospital participants did not require approval from the hospital's IRB as long as participants signed their individual consent forms. The president of business development verified this information.

To gain access to participants, I obtained permission from the college and high school students and laboratory scientists. Participation was voluntary. Participants learned of the study by an invitation letter posted in a designated area chosen by the administrators of the high school, a college professor, or a laboratory administrator. After reading the posted invitation, participants notified me of their interest in the study. Participants received consent forms, the invitation to participate, and the letter of cooperation via e-mail.

In order to establish a researcher-participant relationship, the researcher e-mailed participants a letter of cooperation explaining the purpose of the study along with a brief description of the CLS profession (Appendix E). I e-mailed all informed consents to all participants for their immediate response. I asked participants to reply to e-mail with the words "I consent," meaning they understood the terms described in the consent form and agreed to participate in the study. I waited five days for a return consent or e-mail reply from participants who chose to participate. After five days without response, participants received a five-day reminder e-mail. The e-mail was a reminder notice of the study that emphasized students must return the consent to me or reply to the e-mail stating, "I consent" to participate in the study. Focus groups interview questions were given to participants on day of focus-group session for individual interview questions (Appendix

F & G). According to Glesne (2011), it is essential to gain permission of people who partake in the study, especially when entering an organization with the option of who can and who cannot participate in the study. I respected participants' time and privacy, obtained informed consent, and avoided biases as best as possible (Glesne, 2011).

In addition to establishing a good effective working relationship with the participants, I remained ethical throughout the study by continuously being aware of and working to suspend any personal perspectives. A separate consent form was prepared for all three groups of participants. There was a consent form for high school students, another for college students, and lastly one for CLS participants. I e-mailed all consent forms to participants who agreed to participate. I also scheduled the time of focus-group sessions and or individual interviews according to the participants' schedules. I made sure interviews or focus-group sessions would not affect the students' class time or work hours. I informed all participants they had the right to resign from the study without penalty if they decided not to participate.

I did not collect data until I obtained approval from Walden's IRB. Walden's IRB approval was the only approval the researcher was required to gain prior to collecting data for the project study. The IRB ensures that participants remain anonymous and each participant grants permission prior to the study through written informed consent. According to Lodico et al. (2010), obtaining informed consent, ensuring protection from harm, and protecting confidentiality are ethical concerns in qualitative research.

All data were collected, analyzed, and coded using Interpretative Phenomenological Analysis (IPA). The study utilized IPA with an aim to offer insights

into how a given person makes sense of a given phenomenal relating to experiences (Biggerstaff &Thompson, 2008). Participants could view data findings whenever they chose, which also ensured all data were transcribed properly. During the coding procedure, data were not associated with participants' names and their private information, and the coding did not disclose personal experiences. I limited access to this information to myself, and I will keep the collected data in a locked file cabinet within my home for five years and once the research has been completed and its results validated, all written and electronic data will be erased and destroyed. I will use data deletion methods to ensure data cannot be recovered for all electronic files consistent with technology best standards. However, I will destroy all written documents by cross-cut shredding, or burning. I kept e-mailed and/or scanned documents on my password-protected computer, and I will delete them in five years. I will delete the files from the computer's hard drive by downloading the information onto a disk disposable software designed for data deletion. I will take the necessary steps to dispose of all physical and digital data completely.

The researcher contacted participants by a letter of cooperation and a follow-up e-mail to seek their interest in participation in the study. The study also asked participants to return their signed consent letter to me prior to the collection of data. To capture information for this qualitative phenomenological study, data collection included all instruments previously listed for individual interviews and focus group interviews (Lodico et al., 2010). Human beings are the primary instrument of data collection in qualitative research; I decoded the findings through direct observations, interviews, and

answers from the questionnaire (Lodico et al., 2010). Using multiple data sources assisted me in validating the findings through a process known as triangulation. According to Marshall and Rossman (2011), data triangulation involves using different sources of information to check and establish validity; doing so increases confidence in research data, creating innovative ways of understanding a phenomenon.

Data Collection

The data collection process began with focus-group interviews with students in high school and college. The focus-group interview of high school students took place in the school's counseling office. The college-student focus-group interview took place on the campus in a reserved conference room. Individual interviews with the laboratory scientists took place in the lab conference room. All interviews lasted between 30 and 90 minutes. I made sure the period of data collection was flexible in case participants would want more time to share during the interviews. The following excerpts describe in further detail the type of data collection that occurred throughout the study.

Focus-Group Interviews

Focus-group participants received a letter of cooperation prior to scheduling of group session. The study used focus groups when interviewing the college and high school students and used questions established prior to the initial interview (Appendix F). According to Creswell (2012), the use of a focus group may be helpful in establishing the meaning and interpretation of the phenomenon in question. The focus-group session ranged from 30-60 minutes for participants from a selected college and high school. For

convenience of students, I conducted focus groups at the designated school in the counseling office to eliminate distractions.

The administrator in the department received information about the background of CLS professionals, career opportunities, and NAACLS guidelines on accreditation (see Appendix E). After data collection, I focused on comparing the groups of students and their attitudes and perceptions on career selection factors and incentive measures that might attract individuals to CLS. The selection of questions to discuss focused on topics on the appeal of the profession. The other questions focused on impressions of the career and what focus facts might be useful in attracting individuals to the profession (McClure, 2009). According to McClure, inductive logic uses a repetitive group of observations to reach a general conclusion as to why students have a particular impression about a career in CLS.

I used an audio tape recorder with transcription capability to record the focus-group interview sessions. After I analyzed data from the focus groups, I kept the tapes securely in the laboratory administrative office on the second floor in the hospital. The qualitative research methodology, using descriptive and reflective notes, coding, and member checking, is an important aspect of the study. According to Smith and Larkin (2009), with adaptations suggested by Bloomberg and Volpe (2012), *epoch* is the nature and meaning of setting aside prejudgments, biases, and preconceived ideas about things. The concept of epoch depends on using a phenomenological research method.

Phenomenology involves the study of experiences of individuals as opposed to groups or cultures. I sought to discover the essence of the phenomenon of what attracted

individuals to the CLS profession and the perception of CLS as a career choice. I reported on what the individuals ascribe to their experience (Creswell 2012) and reduced the meanings of all of the individuals to an essence that describes the experiences of CLS students, CLS professionals, and CLS educators and how they communicated and became aware of CLS. For this reason, it was important to record audio during data collection so there was a record of information obtained.

Individual Interviews

To increase the credibility of the data from the interview process, the study used a technique known as member checking to affirm the participants' summaries or views on the qualitative research study (Glesne, 2011). I selected participants who were knowledgeable about the clinical profession, such as CLS professionals, for interviews (Appendix G). The individual interviews sessions lasted 45-90 minutes for the laboratory scientists; however, the time did go longer with two participants because both participants provided more detailed responses to the formatted individual interview questions.

I used a semi-structured interview for the collection of data. Using open-ended questions, the interviewee had the opportunity to answer with an in-depth response to give inductive feedback on the topic and research questions (Glesne, 2011). The focus of these interviews was on whether laboratory scientists were mindful of factors that emerged from the drastic crisis of laboratory scientist shortage due to accredited programs closing, lack of communication of the profession to high school students, and the retiring of laboratory scientists.

Data Recording Measures

A digital audio recording device recorded verbatim responses of all participants. Interviews were either one-on-one or in focus groups. Recording the interviews allowed me to take notes during the interviews. I will keep the tape recordings in a secure cabinet for five years and afterwards will destroy them by physically erasing all data from the tape.

A professional service specializing in handling a wide variety of audio transcripts transcribed the audio. I edited all nine transcripts, one for each individual interview with the scientists and one for each focus group, eliminating non-words and frequent speech patterns elicited by both participants and myself in the transcripts. Non-words include sounds like “ah” and “um.” Frequent speech patterns—usually at the opening of sentences—include phrases such as “You know” and “And so.” Where there were questions of questionable intent spoken by participants in the study of transcripts, the researcher referred to audio tapes for guidance and/or correction.

Data Analysis

Smith and Osborne (2015) outlined steps for phenomenological qualitative data analysis, which the study followed. Smith developed interpretative phenomenological analysis (IPA) to allow rigorous exploration of idiographic subjective experiences and, more specifically, social cognition (Smith & Osborn, 2015). IPA’s theoretical underpinnings stem from phenomenology, which originates from attempts to construct a philosophical science of consciousness, from hermeneutics (the theory of interpretation), and from symbolic-interactionism, which posits the meanings an individual ascribes to

events are of central concern, but are only accessible through an interpretative process (Biggerstaff & Thompson, 2008).

I used open coding, comprised of a brainstorming technique developed by Corbin and Strauss (2014), and followed by extracting narrative data from the interconnectedness and commonalities of the categories. In open coding, I reviewed the data thoroughly prior to grouping and labeling concepts. Coding involves reading raw data and extracting concepts, and then concepts to themes develop. Coding is especially suited to studies that aim to relate findings to bio-psycho-social theories that dominate current thinking within the healthcare professions (Smith & Osborn, 2015).

In the study I used IPA for the analysis and interpretation of data. IPA is of particular use when participants' own phenomenological perspectives are of interest. In these instances, the researcher is interested in gaining an understanding of each individual's own perception of the world and collectively interpreting these perspectives in relation to the research questions (Corbin & Strauss, 2015). The relativist viewed that knowledge was individually constructed is taken during this process, as IPA is interested in participants' mental processes and recording what was real in participants' minds (Smith & Osborn 2015). The data analysis process included the following steps:

1. Reading transcripts several times and taking notes that were descriptive and identified early associations or interpretations.
2. Identifying emergent themes from the transcripts and early notes.
3. Re-ordering and organizing themes into concepts that cluster together or higher-level units that incorporate themes that are more primary.

4. Throughout steps two and three, referring to transcripts and titling themes primarily using participants' own words.
5. Drawing up a table of themes, indicating clustering and hierarchy, and dropping themes that proved weak or unconnected to final structure (Smith & Osborn, 2015).

The information obtained from participants allowed me to interpret the findings from themes and topics and draw out key issues discussed by participants (Smith & Osborn, 2015). In a phenomenological study, researchers use data coding to read all the pieces of data coded to figure out what is at the core of that code (Dowling & Cooney, 2012). The various data codes and patterns reviewed were communication, incentive programs, career opportunities, visibility of the program, and accreditation of schools. Data from each category or thematic idea were explored subject by subject to monitor the changes or variation in relationship to other factors from within the setting.

Given that this approach of identifying themes in relation to the research questions was data-driven, it was difficult to provide a coding scheme prior to data analysis. The phenomenological approach allowed themes to emerge that relate to students' attitudes toward science fields and a lack of knowledge of the CLS field. It was similarly difficult to anticipate themes from CLS program-enrolled students' and current CLS professionals' data for the same reasons. Some of the anticipated themes related to all participants include a desire to work in a helping profession, enjoyment of science-based work, and a mentor or individual who steered individuals toward this career field.

Limitations

A qualitative, phenomenological study design has inherent limitations that researchers must consider in relation to the results. Unknown factors may have influenced the participants and their responses. Some of the limitations in the study that were not within my control were the ability to collect data from multiple hospitals in another vicinity due to not having access to staff, not being able to collect data from high school or college students during a certain time of year, and the truthfulness of the selected participants. The use of a single high school, college, and hospital setting means the results of this study may not generalize to other settings; students and professionals in different settings may view this issue differently. The small samples similarly limit the ability to generalize these results.

Delimitations

Delimitations of a study are characteristics that limit the scope of inquiry, as determined by the conscious exclusionary and inclusionary decision made throughout the development of the proposal (Salkind, 2010). Thus, the population and sample were defined using inclusion and exclusion criteria. The scope of the research study only addressed the research questions and did not exceed the theoretical foundation upon which I based this research study. Restrictions in the study that could have possibly affected the validity of the research were the instruments used in the study. The tools used in the study were the questionnaire; particular participants chosen for the study, such as CLS students, and experienced laboratory scientists working in the profession. The delimitations served as boundaries for the study.

Validity, Trustworthiness, and Reliability

To ensure the validity, trustworthiness, and reliability of the research, I used several mechanisms. Qualitative validity, according to Creswell (2012), means the researcher checked for accuracy of the findings by employing certain procedures. Creswell (2012) suggested documenting as many procedures as possible to ensure reliability and validity of findings. Validation of findings in qualitative research occurs throughout the steps in the process of the research (Creswell, 2012). This study followed three definite steps.

Step 1 involved randomly checking for errors after transcription. Specifically, the researcher checked transcripts to ensure they did not contain mistakes during the transcription process. This procedure ensured that I examined the transcriptions for accurate content, grammatical errors, spelling mistakes, and appropriate punctuation. This assessment process meant I listened to sections of recordings and crosschecked against the same section in the transcribed document. The second step prevented drifts in code definition. During the actual process of coding, a professional editor crosschecked the meaning of the code applied to a phrase to ensure continuity. All coding discrepancies were appropriately aligned when found. The third check involved cross checking codes between transcripts to ensure coding was consistently applied. Specifically, a professional editor reviewed coding to ensure reliability. Consistency of coding was on agreement at a minimum of 80% of the time. When a discrepancy arose, the researcher reviewed the material and made changes as appropriate.

Researcher's Relationship and Role

In my multiple roles as a laboratory scientist, laboratory supervisor, and educator, I rely upon new generations of students to become attracted to enrolling in an accredited CLS program and eventually obtain a career in the profession. Increasing the awareness and enrollment of students in CLS programs can possibly prevent future shortages of laboratory scientists in the upcoming years. I believe it is important students become educated on the CLS profession opportunities and by doing so, attract students to the career.

Researcher Positionality

Communicating the importance of the career to students in high school is vital in helping to increase the enrollment rates of students in science majors, such as one in CLS. Students having the knowledge of CLS early on are very important for attracting students in the career as respected laboratory scientists. For the last 12 years, I have worked as a laboratory scientist and an allied health educator. I have also served as director for the Clinical Laboratory Assistant (CLA) and phlebotomy programs for the last seven years. I spent five years as a CLS instructor in a hospital, instructing CLS students in their clinical rotations on subjects including chemistry, hematology, and immunology. I have also served as a laboratory supervisor for the past eight years.

I am passionate about CLS, and that is why I have chosen this topic for this study. Having my director from my CLS program as my mentor and friend has also increased my interest in and understanding of the importance of attracting students to the career. My hope in conducting this research study is to set the groundwork for increasing the

class sizes of CLS programs and the Full Time Employees (FTEs) in hospital laboratories. I see the difficulty daily in recruiting laboratory scientists for part-time, full-time, or even registry positions in the lab. The main reason for the limited number of applicants is the reduction of students graduating from an accredited CLS program. Understanding the need for students to become attracted to the career has given me the insight to indulge heavily in research on the factors that may have caused students to lack motivation and/or question their self-efficacy in working as laboratory scientists.

Results

The purpose of this study was to explore students' perceptions of allied health professions and factors that influenced students and CLS professionals to select CLS as a profession. The results section will explain the process from which the data developed, gathered, and the systems described for keeping track of data; provide a detailed description of the findings and the emergent themes; and include evidence to assure the accuracy of data. During the collection of data, I utilized insights from focus groups and individual interviews to make sense of a given phenomenon (Smith, Flowers, & Larkin, 2009). IPA was the approach for the qualitative study because its approach is different from others; it does not test hypotheses, but rather is a combination of lived experiences, life events, and psychological components (Guest, MacQueen, & Namey, 2012).

To organize the qualitative research data for analysis, the advice from Saldana (2012) regarding analyzing qualitative research was to use a computer to track information. The most important steps of Saldana's coding were to manage the qualitative data via qualitative software. The study used the Atlas qualitative software

system for keeping track of data and emerging understandings of phenomena themes in the study. Data were organized, transcribed, manually coded, and displayed on a spreadsheet in the Atlas.ti software for convenience of identifying and comparing the patterns and themes. In the final analysis the computer-assisted, data managerial process resulted in several pages of coded and organized data. Since the content of data was extensive, it was convenient to use Atlas.ti for organizing the data prior to converting it to Microsoft word for the project study. This process helped me significantly with completing the data analysis process (Appendix J) for coding data.

The research questions that guided this qualitative study included:

Research Question 1 (RQ1): What are high school students' understanding and perceptions of the allied health profession?

Research Question 2: (RQ2): What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program?

Research Question 3 (RQ3): What are the factors that influenced CLS professionals' awareness and pursuit of the profession, and what factors are related to their longevity in the profession?

Profile of Participants

I conducted this study in a hospital in Chicago using students from a high school and a university. I used a convenient purposeful sampling of experienced CLS professionals, high school students, and college students in the study. The study sought a specific number of participants for each group to total 21, seven participants in each group. However, the total of participants that actually participated in the study was

seventeen: (a) seven experienced CLS professionals, (b) five high school students 18 years of age or older, and (c) five college students enrolled in an accredited CLS program. Four of the participants were male and 13 were female. An even split of gender was desired; however, the number of possible female participants far outweighed possible male participants among the clinical laboratory professionals, college CLS students, and high school students. The number of males in the area willing to participate and enrolled in a CLS program, experienced in CLS, and in high school and interested in science was low. While striving to attain this balance among gender, I also had to factor in the variation of age ranges for the participants.

The participants' ages ranged from 18-61 (Table 3). The researcher protected the actual names of the 17 participants in accordance with the design of the study and standard qualitative research guidelines (Creswell, 2009). Participants were able to withdraw from this study.

Table 3

Key Demographic Characteristics of Participants

Participant no.	Group	Age
Participant 1	High school student	19
Participant 2	High school student	19
Participant 3	High school student	18
Participant 4	High school student	18
Participant 5	High school student	18
Participant 6	College student	20
Participant 7	College student	20
Participant 8	College student	20
Participant 9	College student	21
Participant10	College student	22
Participant 11	CLS professional	61
Participant12	CLS professional	40
Participant 13	CLS professional	42
Participant 14	CLS professional	37
Participant 15	CLS professional	36
Participant 16	CLS professional	35
Participant 17	CLS professional	35

Data Analysis Findings

I addressed each of the study's research questions by analyzing the sorted codes, emphasizing the textural themes that were developed. My objective was to identify factors relevant to Research Questions 1-4 as reflected in the data from seven interviews. I viewed each individual interview as a single incident. I considered each interview individually in the analysis, and I identified common themes across the data with regard to addressing the research questions. The process of data analysis involves "making sense out of text and data, and preparing the data for analysis, conducting different analyses, moving deeper and deeper into understanding the data, representing the data, and making an interpretation of the larger meaning of the data" (Creswell, 2009, p. 183).

I searched for patterns, themes, and dimensions in the data through analysis of the interviews, coding of the data, and further analysis as themes and patterns emerged. The goal was to describe the participants' subjective experiences and views.

The first level of identification occurred during the initial review of each interview transcript. Upon receiving the transcripts, I read each transcript, analyzed the data for each interview, and then conducted coding. I describe the resulting themes and subthemes in the summary of the research findings. The coding process identified 12 primary themes. Several of the themes were further classified into subthemes, and one subtheme was comprised of nodes. I summarized the findings for the research questions and used brief exemplar quotes from the interviews to illustrate the themes, subthemes, and nodes.

Results for Research Question 1

Research Question 1 asked: What are high school students' understanding and perceptions of the allied health profession? I summarized the primary themes related to this research question in this section. This section includes a table summarizing the definition of the identified theme, the frequency of occurrence for the themes and subthemes, and the number of interviewees that mentioned a specific theme or subtheme. As reflected in Table 4, the primary themes were: (a) draw blood, (b) run tests, (c) do not know, and (d) surgery. Table 4 also indicates the frequency with which the themes appeared across interviews.

Table 4

Frequency of Themes for Research Question 1 ***Error! Bookmark not defined.***

Themes	Mentioning (*n*)	Exemplar quotes (*n*)
Draw blood	4	7
Run tests	3	6
Don't know	4	5
Surgery	3	5

Primary Theme: Draw Blood

The most frequently occurring theme for Research Question 1 was *draw blood*. Draw blood comments referred to by the high school students in the peer group is the process and procedure the allied heaths professionals utilize for drawing the patients' blood. The high school students this theme seven times in four interviews. Participants 1-4 all mentioned they believe drawing blood is a part of the profession.

Theme 2: Run Tests

The next frequently occurring theme was *run tests.* This statement of running tests is the idea of laboratory professionals performing the tests in the lab to obtain a clinical result to report to physician. The high school students mentioned this theme six times in three interviews. Participant 2 said, "The type of job I think that are in the CLS field is drawing blood, running test and person who prepares for all testing." Participant 5 shared, "I think they run scans and test for clinical problems like mental and physical conditions."

Theme 3: Do not know

The next theme was *do not know*. The term referred to statements by high school students that they do not know much about the allied health profession. The theme came

up five times in four interviews. Participants 1, 3, and 5 stated they did not "know anything" about the CLS profession.

Theme 4: Surgery

The following theme was *surgery*. This term referred to by high school students' perception that they believe CLS are involved in surgery. The theme arose five times in three interviews. Participants 1, 3, and 5 mentioned they believe CLS professionals play a part in surgery. Participant 1 stated, "Not sure to what a Clinical Laboratory Scientists is but it sounds like some type of procedure being done by a scientists." Participant 3 stated, "yes like a surgeon would do repairing a patient's body the scientists would do some type of surgery on the patients' blood". Participant 5 stated, "yes sounds like a Clinical Laboratory Scientists does some type of experimental work or procedures."

Results for Research Question 2

Research Question 2 asked: What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program? This section summarizes the primary themes related to this research question. Table 5 summarizes the definition of the identified theme, the frequency of occurrence for the themes, and the number of interviewees that mentioned a specific theme. As reflected in Table 5, the primary themes were: (a) science, (b) own investigation, (c) healthcare, and (d) family in healthcare. Table 5 also indicates the frequency the themes appeared across interviews.

Table 5

Frequency of Themes for Research Question 2

Themes and subthemes	Mentioning (*n*)	Exemplar quotes (*n*)
Science	4	6
Own investigation	4	6
Healthcare	3	4
Family in Health Care	3	2

Primary Theme: Science

The most frequently occurring theme for Research Question 2 was *science*. This term referred to when college students mentioned that an interest in science was a factor that influenced the awareness and decision to enroll in a CLS program. The theme was mentioned six times in four interviews. Participant 9 shared, "I've always had an interest in science. As I progressed in my studies, I began to learn about different fields of science." Participant 8 said, "Looking back on it, I always liked chemistry and biology."

Theme 2: Own Investigation

The next frequently occurring theme was *own investigation*. This term refers to when college students mentioned that they found out about CLS through their own investigation. It came up six times in four interviews. Participant 10 said, "… Upon investigation, I felt that CLS fit perfectly with what I wanted to do as a career." Participant 10 also stated:

> I would ask people in the hospital cafeteria when visiting family members what their career path was. . . in and one person mentioned she was a Medical Technologist and she explained the role to me and I liked how it

> sounded and so I goggled it more and enrolled in it after graduating from my associate degree.

Participant 10 also shared:

> I could not believe that when the high school I attended had career fairs that no one from the laboratory profession attended and she did not understand why, maybe it was that the teachers and principal were not aware of the field.

Participant 8 shared,

> I knew I liked science, so I got on Illinois State University website and did a "control + F" search of the Academic Majors page for the word *science*. Medical Laboratory Science was listed, and I had never heard of it before, so I checked it out and decided to switch.

Participant 8 also stated, "after I enrolled in Medical Laboratory Science at ISU I couldn't have been happier. I just wished I knew more about the profession before entered college by a counselor or teacher at Simeon High School, but that didn't happen."

Theme 3: Healthcare

The following theme was *healthcare*. This term referred to mentions by college students that getting into the healthcare field was what played a factor in deciding to enroll in a CLS program. It emerged four times in three interviews.

Participant 9 shared:

> As far as social factors, I know that there are a lot of diseases and illnesses that have affected my family and friends, so in regards to clinical laboratory science, I

> could one day be a part of a research team to help with a cure for any of the many diseases and illnesses that exist.

Participant 6 said, “Having the opportunity to play a role in the patients' healthcare in a ‘behind the scenes’ sort of way’ was what made the CLS profession attractive.” Participant 8 echoed, “I also wanted to be in healthcare and help people, but I didn’t want to have a lot of direct patient contact.”

Theme 4: Family in Healthcare

The next frequently occurring theme was *family in healthcare*. This term referred to college students mentioning a family member in healthcare influenced their decision to enroll in a CLS program. The term surfaced three times in two interviews. Participant 7 shared, “My older cousin is a CLS [and] that made me interested in learning about it I’d never heard of it before her.” Participant 7 also shared,

> I know from conversations with my cousin that she was not aware of CLS when she entered college and I know she was pre-medicine the first two years, but she too had no idea of a CLS professional and I am astonished that no one prior told her of a laboratory science career path.

Participant 6 added, “My family is all in the medical field.”

Results for Research Question 3

Research Question 3 asked: What are the factors that influenced CLS professionals’ awareness and pursuit of the profession, and what factors relate to their longevity in the profession?

Table 6

Frequency of Themes, Subthemes, and Nodes for Research Question 3 and 4

Themes, subthemes, and nodes	Mentioning (*n*)	Exemplar quotes (*n*)
Negative factors of CLS		
Understaffed	4	4
More work	4	6
Errors	3	6
Lower quality care	3	4
Underpaid	6	8
Not respected	5	6
Lack career growth	3	4
Factors that attracted to CLS		
Science	4	5
High demand	4	5
Healthcare	3	4
Good pay	3	3
Factors to stay in CLS		
Help others	3	6
Interesting work	4	4

This section summarizes the primary themes related to this research question. This section includes a table summarizing the definition of the identified theme, the frequency of occurrence for the themes and subthemes, and the number of interviewees that mentioned a specific theme or subtheme. As reflected in Table 6, the primary themes were: (a) negative factors of CLS and (b) factors that attracted to CLS. Table 6 also indicates the frequency with which the themes, subthemes, and nodes appeared across interviews.

Primary Theme: Negative Factors of CLS

The most frequently occurring theme for Research Question 3 was *negative factors of CLS*. The theme was comprised of four subthemes, including: (a) understaffed,

(b) underpaid, (c) not respected, and (d) lack career growth. I further stratified one subtheme within the qualitative analysis program into additional nodes.

Primary subtheme: Understaffed. The primary subtheme was *understaffed*. This term referred to mentions that CLS field is understaffed. The subtheme appeared four times in four interviews. Participant 14 said, "[T]here is definitely a shortage of laboratory professionals. When we have openings in our lab we typically have to wait for our students to graduate to … fill them." I stratified additional exemplar quotes into three nodes.

Node 1: More work. The primary node was *more work*. It referred to mentions that understaffing leads to more work and responsibilities for those in the profession. It materialized six times in four interviews. Participant 13 shared, "I have been required to multi task more often, assist co-workers, especially the older ones, in keeping up with the increase in work due to the shortage." Participant 17 added, "We now expect fewer CLS workers to accommodate the same number of patients …. in a shorter time." Participant 16 echoed, "The shortage of CLS has affected my personal workload by not having enough staff to cover my schedule."

Node 2: Errors. The following node was *errors*. This term referred to mentions that understaffing increased the likelihood of making mistakes. The term occurred six times in three interviews. Participant 16 stated, "As mentioned, understaffing can lead to decrease in productivity, overworked, burned out employees, less accuracy and attention to detail contributing to mistakes and errors that could have been avoided." Participant 16 said, "Even when CLS workers are competent, the overworked/stressed environment

introduces mistakes. I must constantly reevaluate to train ways to prevent mistakes." Participant 13 added, "Too much on the workload will only increase lab errors, which will ultimately affect the care and treatment provided to the patients."

Node 3: Lower quality care. The next node was *lower quality care*. This term referred to mentions that understaffing could lead to lower quality patient care. The term arose four times in three interviews. Participant 12 mentioned how automation of some tasks for CLS in the laboratory has been innovations to help with the effects of the shortage of staff, saying, "These employees do not have a full comprehension of the testing they are performing because of the automation. There is not appropriate investigation into abnormal results as a result of this." Participant 12 also stated, "there will also need to be CLS in the department to review results and to be sure all are accurate before being reported to the physicians; therefore, automation is not the key and will negatively impact quality of results for physicians." Participant 16 simply stated, "I foresee a decrease in the quality of patient care as a result of a shortage of CLS." Participant 16, also stated, with the baby boomers retiring soon I am not sure how administrators of the hospital will be sure physicians will get results in a suitable time when the enrollment of students is scarce, but the amount of tests physicians' order is at an increase."

Subtheme 2: Underpaid. The following subtheme was *underpaid*. This term referred to mentions that CLS do not earn enough money. This term appeared eight times in six interviews. Participant 14 shared, "Even though it is a rewarding career, the lack of visibility resulting in inequitable salaries is concerning. It is difficult to justify the fact

that some associate degreed allied health professions have a higher entry level salary." Participant 11 also said, "I … feel that we are underpaid compared to nurses or other allied health field positions." Participant 12 added, "I feel the pay is less than other jobs that have more patient contact."

Subtheme 3: Not respected. The following subtheme was *not respected*. This term referred to mentions that CLS are not as respected or recognized as they should be. The subtheme surfaced six times in five interviews. Participant 16 said, "We work behind the scenes and have been forgotten about and not appreciated by administrators and other personnel in the hospital for what we do." Participant 15 elaborated:

> People do not really know what we do and they do not think it requires any degree. We are less valued, and it shows by the level of respect we get within healthcare institutions, the lack of knowledge about the profession, the lack of pay compared to allied health professions that only require an associates' degree etc. We are behind the scenes but play a major role in health diagnosis and outcomes.

Subtheme 4: Lack of career growth. The next subtheme was *lack of career growth*. The term referred to mentions that there is a lack of career growth in the field. The term surfaced four times in three interviews. Participant 13 shared, "Early in my career I felt there would be lots of growth opportunities. However, I do not feel the same anymore." Participant 12 said, "Many times to advance you have to leave the lab and go into a company's sales or diagnostic area."

Theme 2: Factors That Attracted Me to CLS

The next frequently occurring theme was *factors that attracted me to CLS*. The term referred to mentions factors that influenced CLS professionals to pursue careers in the field. The theme was comprised of four subthemes, including: (a) science, (b) high demand in field, (c) healthcare, and (d) good pay and insurance benefits.

Primary subtheme: Science. The primary subtheme was *science*. The term referred to mentions that an interest in science is what influenced CLS professionals to pursue the field. The subtheme materialized five times in four interviews. Participant 14 shared, "I also loved my lab courses in high school then heard about the field during a career day." Participant 13 said, "What initially attracted me to clinical lab science was the forensic science [specialty]."

Subtheme 2: High demand. The next subtheme was *high demand*. The term referred to mentions that the expected high demand of workers in the field is what influenced CLS professionals to pursue the field. The subtheme came up five times in four interviews. Participant 16 shared,

> The Bureau of Labor Statistics as well as studies conducted by ASCP predicted a shortage of medical technologists entering the field due to a lack of knowledge of the career, closing of MT programs, and retiring population. Therefore, the job outlook was good, being in demand.

Participant 13 said, "It was easy to find jobs to apply for and I was even hired before I graduated."

Subtheme 3: Healthcare. The next subtheme was *healthcare*. The term referred to mentions that CLS professionals pursued their career path because of a desire to be in the healthcare industry. The term arose four times in three interviews. Participant 16 shared, "My career goal has always been to help others in some way in the medical field. I originally wanted to become a physician." Participant 15 said, "I have always wanted to be in the medical profession. I started out as a pharmacy major, but realized that it did not really fit for me."

Subtheme 4: Good pay. The following subtheme was *good pay*. The term referred to mentions that CLS professionals were attracted to the field because of the good pay came up three times in three interviews. Participant 16 shared:

> At the time I learned about the career of being a medical technologist, I lived in California. California is one of the few states that pay the highest salary for MTs. Therefore, I was impressed with the career and the potential to make good money. However, I relocated to upstate NY, and the pay was much less, as is here in the Midwest.

Participant 13 said, "Financially, during the course of my studies I was told that the pay was great."

Summary of Key Findings

Research Question 1 (RQ1): What are high school students' understanding and perceptions of the allied health profession? (Appendix H). Key findings for RQ1 were extracted from the five participants, and four major themes were discerned from the participants. The first theme, "draw blood" emerged the most from the five participants.

The first theme came up four times. The second and third theme discussed more by participants was that the high school students' perceived allied health profession in particular CLS as job duty of "Performing surgery daily" and also "run tests". The second and third themes both arose 3 times. However, the last theme mentioned, "I do not know" by the high school students' surfaced 4 times.

The participants from RQ1 did answer the question to the best of their ability. It is apparent out of the five participants, most of the participants according to their responses and exemplary quotes were not aware of what the allied health professional in the field as a CLS does daily on the job. A CLS does not draw blood /perform a venipuncture daily, and a CLS will never perform surgery and or draw blood for a surgeon. A few participants did state that CLS do run tests. However, there were still more exemplary quotes and mentions from the high school students that they simply "do not know" or "do not know anything about CLS". The researcher interpreted from RQ1 that the high school students' are not aware of the CLS profession according to the coded themes extracted. With these students not knowing what a CLS professional does daily or not being aware of the profession, they have no reason to pursue the profession in college. The profession will continue to lack qualified CLS until more students are educated on the CLS profession.

Research Question 2: (RQ2): What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program? Research question 2 (RQ2) key findings from the ten participants regarding the college students' decision to enroll in a CLS program extracted four themes. The first theme coded "science" arose

four times. These students enrolled because of their interest in science, and because of this interest in science, one student mentioned interest in science is what made them seek out CLS. The second theme discerned from RQ2 was "own investigation." The second theme surfaced 4 times. The third theme discerned from RQ2 was "healthcare." This theme emerged 3 times, while the last theme "family in healthcare," was mentioned two times from the 10 participants.

The themes that were coded from the ten participants did answer the RQ2. It is apparent the 10 participants enrolled in the CLS profession in college because of their own investigation, being inquisitive while in the healthcare setting, or because of their interest in science courses in college or high school. The college students did not mention at any time that they knew about the CLS profession prior to doing their own investigation and when they sought out the profession, they enrolled on their own. These students were not aware of the CLS profession any time prior.

Research Question 3 (RQ3): What are the factors that influenced CLS professionals' awareness and pursuit of the profession? Both positive and negative factors influenced CLS to pursue a CLS profession, and stay in the profession. The CLS professionals did mention several negative factors of the CLS profession that were coded and categorized, such as the profession being understaffed, more work, increase in errors, underpaid, not respected and lack of career growth.

Table 7

Summary of Themes

Themes, subthemes, and nodes	Mentioning (*n*)	Exemplar quotes (*n*)
Research Question 1		
Draw blood	4	7
Run tests	3	6
Don't know	4	5
Surgery	3	5
Research Question 2		
Science	4	6
Own investigation	4	6
Healthcare	3	4
Family in healthcare	2	3
Research Question 3		
Negative factors of CLS		
Understaffed	4	4
More Work	4	6
Errors	3	6
Lower quality care	3	4
Underpaid	6	8
Not respected	5	6
Lack career growth	3	4
Factors that attracted to CLS		
Science	4	5
High demand	4	5
Healthcare	3	4
Good pay	3	3

Some of the positive factors coded that were mentioned from participants regarding what made the CLS professionals stay in the field are first, “love for science,” second, “interesting work,” third, “field in high demand,” and lastly “enjoyment of science labs while enrolled in college.” Some of the negative factors coded from the CLS are, first they believed the staff’s longevity could negatively influence the profession. Second, the participants reported the “pay is less,” and many people do not know what CLS specialists do, and are underpaid compared to nursing,” third “lack of career growth,” and lastly CLS are not respected by other clinicians in the health care setting.

Project as an Outcome

Due to the nature of the problem in this study and the project genre, the study provided a theoretical framework that would support the development of a career-awareness program for high school science teachers and their students. Current literature was one of the tools the researcher used in triangulating this study, and the review of the literature revealed career awareness for both teachers and students was a valuable asset to assist in the communication, awareness, attraction, and motivation of students to enroll in an accredited CLS profession in the twenty-first century (McClure, 2009).

Subsequently, having science teachers inform students of the CLS profession in high school and college will increase the amount of CLS professionals employed in hospitals or clinics to prevent further shortages in the allied health profession. Current literature revealed students required ongoing motivation to remain dedicated to CLS once they are in the profession to ensure they remain in the profession for years (McClure, 2009). Therefore, students may benefit more from a career-awareness program for high school science teachers than a career-awareness program geared for counselors or principals of high schools to increase enrollment of students in CLS programs.

I understood the need to explore multiple perspectives in the role as a researcher. According to Creswell (2012), researchers participate in the spiral of analysis of data by gathering data, categorizing data into themes, interpreting, and visualizing the data. For example, experienced laboratory professionals and colleges students expressed they enrolled in an accredited CLS program expressed due to their interest in science and a desire to work in healthcare. From the study findings, the researcher found there were

reasons why there was a need to develop a professional workshop for high school educators that would implement CLS into the students' science curriculum. Additionally, the career-awareness program is to meet the needs of students and retaining CLS in the profession; motivation needs to be effective within both populations to ensure the dropout rates, or change of profession does not still influence the CLS profession.

Conclusion

The purpose of this study was to explore high school students' understanding and perceptions of allied health professions, the factors that influence college students in CLS-related programs and CLS professionals to select CLS as a profession, and the anticipated consequences should the field not adequately address the shortage. I did not collect any data until approval from the IRB, nor did she recruit or outreach to any participants until IRB approval arrived. Once IRB granted approval, I proceeded to recruit participants, collect data, and analyze data. I chose to do interviews to study the lived experiences of the participants; specifically, how those experiences develop into participants' views of different groups perceived the shortage of clinical laboratory scientists in the new generation.

I used interpretation and analysis of the interview data collected to develop a career-awareness program for community high school science teachers in Chicago. The larger goal is to fill the gap of the shortage of CLS professionals in society by possibly increasing the enrollment of CLS students in an accredited program. Included in the methodology chapter is a narrative description of the selection of participants and proposed data collection and data analysis techniques. I took precautions, including peer

debriefing and triangulation, to ensure the study upheld reliability, credibility, validity, and trustworthiness.

Section 2 included a detailed exploration of the relationship that existed between the lack of awareness and communication of the CLS profession in the twenty-first century. I used IPA as the qualitative methodological strategy to examine the lived experiences, life events, and social cognitions of participants (Smith & Osborn, 2015). Using IPA, I examined the interview data, which was rich in nature and provided insights into the understanding of each participant's perception of the world, mental processes, and the central phenomenon under investigation to generate a theory or concept (Creswell, 2012). In this chapter, I provided a detailed discussion of the methods used to conduct the study. I also presented the rationale for use of a qualitative phenomenology study, along with a discussion of the process for participant recruitment and the ethical assurances provided to all participants.

I explored three research questions in this research study, including:

RQ1: What are high school students' understanding and perceptions of the allied health profession?

RQ2: What are the factors that influence college students' awareness of, and subsequent decision to enroll in, a CLS program?

RQ3: What are the factors that influence CLS professionals' awareness and pursuit of the profession and what factors relate to their longevity in the profession?

Based upon the analysis of research data, I developed a career- awareness program curriculum for science teachers and their 11th and 12th grade students were

developed. The purpose of the career-awareness workshop was to assist science educators with preparing high school students for life skills and career development training so they are more aware of different professions available to the 21st century workforce, especially careers in the science profession. Section 3 provides information for the proposed career-awareness program curriculum that is part of this project study. Section 4 includes the results and recommendations for future study.

Section 3: The Project

Section 3 includes the final project I developed using the findings from the focus-group sessions and individual interviews. In the first section, I present and explain the project, including the directions for each stage of development, the description of the goals, the rationale for the project, and a literature review to support the selection of the project genre. I also describe implementation strategies, a proposed project evaluation, and implications for social change.

Brief Description of Project

The implementation of a career-awareness workshop to be included in the science educators' curriculum was the focus of the project. I developed this career-development workshop based on the findings of this study, which indicated such a program would benefit the CLS profession by increasing the awareness of this profession among high school students. The findings indicated a curriculum with a development workshop would be the most appropriate solution to the identified research problem regarding science teachers directly affecting students' awareness of CLS. This workshop has the potential to increase the enrollment of students in an accredited CLS program. I created the 3-day professional-development workshop to provide high school science teachers with the expertise needed to promote CLS awareness in their curricula using a career-development framework.

The purpose of the project was to promote the CLS profession to high school students, using science teachers as the facilitators who initiate career awareness into their existing curricula. The 3-day professional-development workshop will provide science

teachers an opportunity to update their curricula to include CLS principles and clinical skills that promote awareness of and enthusiasm for the CLS field.

In this project, I incorporated various evaluations, including a daily formative evaluations and a summative evaluation the science teachers will use on all three days of the workshop (Appendix A). As the literature suggests, science educators incorporating career-awareness into the curriculum will increase students' knowledge of allied health professions, in particular CLS (Cullen & Harris, 2012). According to Cullen and Harris (2012), science educators and guidance counselors need to implement systemic change and examine the current curriculum to meet high school students' needs. This project offered an opportunity for positive social change that could promote the awareness of allied health professions in high schools. The project may encourage high school students to seek careers in the allied health professions.

Descriptions and Goals of the Project

The project is a 3-day professional development-training workshop. The goals and objectives of the workshop focus on increasing awareness of CLS professions among high school science teachers and students. The purpose of the project was to increase the knowledge and understanding of the CLS profession among science teachers, which could possibly increase student enrollment in accredited CLS programs in college. High school orientation coordinators will present the 3-day professional-development training workshop to high school science teachers. The professional-development training will be part of the teachers' orientation hiring sequence at the high school in which the teachers

work. The 3-day workshop will be a mandatory in-service for all new science teachers hired.

The program participants will be 15 science teachers working in the local high school district. Teachers who participate in the workshop will gain knowledge and understanding of the CLS allied health professions and will integrate this information into the high school science curricula. The data from this study indicated that high school students are not aware of the CLS program. Increasing awareness of CLS programs among high school science teachers may encourage them to discuss CLS jobs more readily in the classroom, thereby increasing high school students' awareness and consideration of CLS careers. Enhanced awareness of CLS by high school students may mitigate the shortage of CLS practitioners.

The design and direction for planning the career-awareness workshop were adapted from the work of Schilling, Schwallie-Giddis, and Giddis (2011). Tyler's (1986) model of curriculum development was the basis for the model used for developing the curriculum of a career-awareness development program. I also used Bloom et al.'s taxonomy of educational objectives for measuring the learning outcomes based on levels of objectives (Clark, 1995).

The 3-day workshop will enhance the educators' skills on the various steps involved in designing, developing, and implementing curriculum on career awareness for high school students. Career awareness for high school students is an essential element for their personal and professional growth in the 21st century. The workshop facilitator will use Bloom's taxonomy (Figure 3) as a model of learning objectives for the high

school science teachers' learning outcomes (Bloom, 1956). The workshop will also present cognitive dimensions as hierarchical steps and the types of knowledge the industry may expect teachers to acquire (Huitt, 2009).

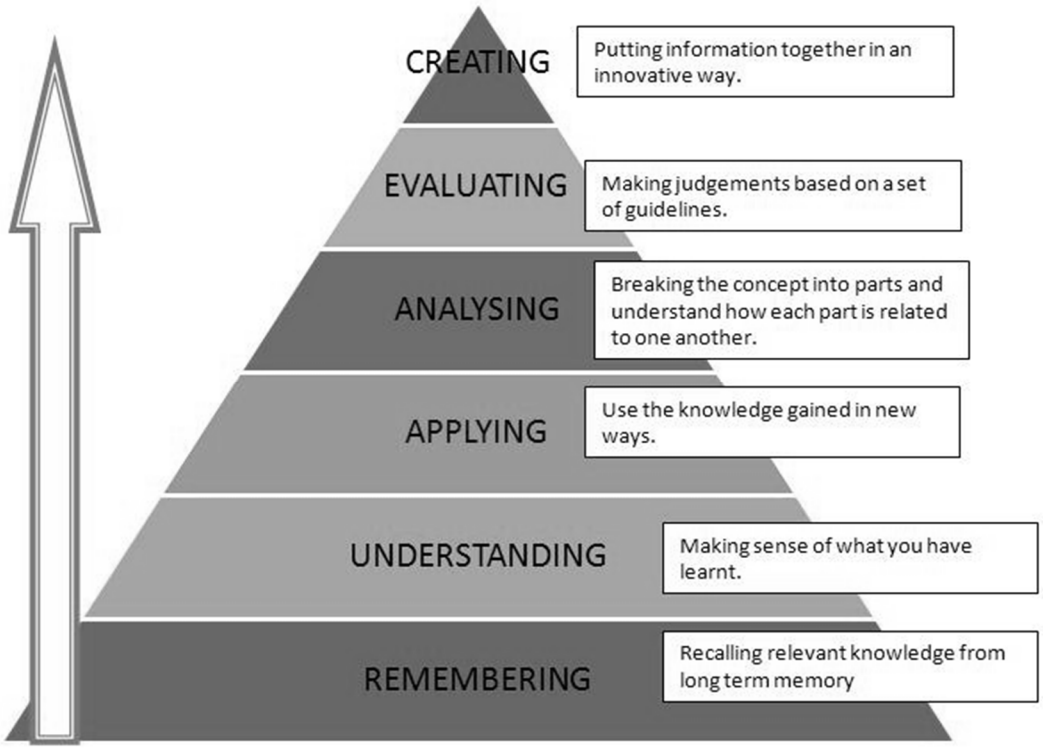


Figure 3. Bloom's taxonomy of cognitive domain.

Upon completion of the 3-day career development workshop, participants will be able to do the following:

1. Understand, interpret, compare, and contrast the CLS careers in health care.
2. Define career awareness and career-development programs.
3. Apply knowledge to implementing career-awareness programs in the high school science curricula.
4. Identify the organizational structure of allied health programs.

5. Identify different health care programs and how they affect society's needs.
6. Use the CLS professional-development workshop to create a career-awareness program at their high school.

Participants may realize these outcomes through engagement in various learning activities. The facilitator will assess daily measurable objectives throughout the program. A measurable objective that the program developer will use in assessing participant understanding of the career development workshop is a desired outcome of the formative and summative scores of 80% or higher.

Day 1 of the program will focus on career-awareness theories and cultural context for career-awareness activities. The results of the pre-assessment activity provided to the participants 2 weeks prior to the workshop will inform the content of the sessions. Day 1 objectives for participants include the following:

1. Use resources for different careers and integrate these components into their curricula.
2. Implement career assessment reporting into the students' learning experiences on career choices.
3. Understand the career-planning process, and how it can facilitate the attainment of educational and career goals.
4. Understand and adopt the career-planning model.
5. Describe the purpose of career assessment and how it relates to awareness and staff shortages in allied health professions.
6. Identify both informal and formal career assessments.

7. Understand and use the career development four-step process.
8. Collaborate on how to get jobs using career success tools.
9. Describe project learning to enhance students' awareness of the CLS profession.

During Day 2, workshop participants will examine different career concepts and career-learning processes science teachers can integrate into their high school science curricula. The following learning objectives will guide the instruction for Day 2 of the career-awareness development program for science teachers:

1. Discuss the different career-awareness educational tools and additional resources available for career development and awareness.
2. Use a career and education planning worksheet in exploring occupations.
3. Demonstrate their understanding of career awareness by successfully completing the student-goal scenario worksheet.
4. Identify and explore students' awareness of personal perspectives on career issues and individual differences.
5. Help students understand the importance of setting realistic goals.
6. Recall career options from the Internet exercise on career exploration.
7. Prepare a lesson plan on career awareness for the science curriculum.

Day 3 will focus on dissemination of knowledge and information sharing as related to planning skills, careers in CLS disciplines, and curricula. The following participant objectives will guide the instruction for Day 3:

1. Define the importance of setting goals and the importance of goal attainment.

2. Define CLS allied health careers.
3. Distinguish among the various jobs that are available as a CLS professional.
4. Administer and assess a career-planning form for students interested in CLS programs in college.
5. Use the Internet for navigating college websites, which include information on the CLS programs.
6. Communicate with high school principals, high school counselors, and hospital administrators about the importance of the CLS profession.
7. Collaborate with school guidance and career counselors on information pertaining to the CLS profession.

I divided the 3-day workshop into three specific learning activities and objectives for the curriculum. Day 1 introduced high school science teachers to career-awareness theories. Day 2 focused the exploration and examination of different career concepts. Day 3 provided knowledge and information sharing for teachers regarding skills and careers in CLS. The 3-day workshop will be mandatory for all science teachers. During the 3-day workshop, all participants will engage in a formative evaluation, and at the conclusion, participants will engage in a summative evaluation to determine whether they have achieved the learning objectives.

Rationale for the Project Genre and How the Problem Is Addressed Through the Project

From the research part of the project study, I identified three key findings. First, high school students are not aware of the laboratory science professions. The findings

indicated students did not have exposure to the career opportunities available in CLS prior to entering college. Findings from the college students group indicated that they did not know about CLS careers in high school. Third, CLS professionals reported a lack of exposure to CLS in their high school education.

The goal of the 3-day professional-development workshop is to increase high school science educators' awareness of the CLS profession. I will provide study findings and results to the teachers during the workshop's opening-day presentation. The 3-day workshop will use a faculty development approach, with the intent to capitalize on existing skills of science educators. Science teachers will complete the workshop with the skills and confidence necessary to achieve the goal of increasing awareness of the CLS profession. By integrating knowledge of CLS in the existing science courses rather than replacing the curriculum, science teachers will be able to incorporate the concepts in a meaningful way, which is consistent with their instructional style. Teachers are more likely to embrace an opportunity to enhance or improve their curricula rather than develop an entirely new program of study (Huitt, 2009).

I chose the 3-day format for this project study genre because it will provide opportunity for collaboration, ideation, and inquiry among the participants and project planner. This workshop will encourage teachers to expand their teaching abilities and research within the workshop setting. The new knowledge and insights regarding CLS careers learned in the training will promote the integration and implementation of career work products into their curricula. The ability to develop classroom applications will potentially promote teachers' desires for practical learning opportunities. In this 3-day

workshop, the teachers will be in a high school environment. The workshop environment could be a simulated lab, science classroom, conference room, or the high school auditorium.

Review of the Literature

Within the educational setting, training occurs in a variety of genres. Some examples include skill building sessions, workshops, seminars, and peer coaching (Caffarella, 2010). According to Caffarella (2010), program planning consists of ideas about how programs are organized and what is necessary to ensure successful outcomes. The literature review identified the genre or model for planning a career-awareness workshop for high school science educators. Professional development may have a variety of intentions. Within science teachers' professional development, intentions may include raising awareness of CLS or providing career-awareness curriculum to science educators and providing steps on how to implement CLS awareness into high school students' science courses (Dass & Yager, 2009). To choose an appropriate program-planning model, the facilitator must first examine the purpose of the training, learner needs, and societal needs. More specifically, program planners must ensure their program meets the needs of the learners and stakeholders, and other issues that might affect the changing needs and interest of and for learners.

According to Veness (2010) and Tyler's (1949) curriculum model is a model that consists of objectives, instructional strategies and content, organization of learning experiences, and assessment to determine when the educational purposes are met. The purpose of the project is to provide high school science educators with the expertise

necessary to promote CLS awareness within their curriculum using a career-awareness framework.

With this purpose in mind, the researcher conducted a review of literature and limited the topics to the linear program planning model specific to Tyler's (1949) curriculum model; faculty professional development; CLS awareness; and implementation of science curriculum programs, educational learning theory, and career choice theory. I searched EBSCO, ERIC, and ProQuest, as well as other online and conventional library sources/and databases to obtain information for this project. The review of literature offered the researcher the opportunity to bring together concepts on curriculum model and career choice concepts that can foster awareness of the CLS profession for high school science students and science teachers.

Organizing Framework

This section presents the organizing framework based on theories by Bandura (1986) and Krumboltz (1994), and the literature review on the role and purpose of faculty professional development, particularly for science teachers in light of the expanded opportunities of the career field.

Faculty professional development for science teachers could possibly increase career awareness for students. Organizing frameworks and the inclusion of educational theory guides faculty program planning. Organizing frameworks guide career-awareness curriculum development for science courses and provide venues for educational systems and their commitment to career education. Educators who value the worth of all students are the key to the successful development of career-awareness (Lee, 2013). The

organizing frameworks chosen to guide the development of this workshop are Krumboltz's social learning theory of career decision making (SLTCDM; Lent, Brown, & Hackett, 2002) and Bandura's (1986, 2001) social cognitive learning theory.

Krumboltz's career choice theory. The basis of Krumboltz's career choice theory is humans select their careers based on experiences and influences they have had in their life. These experiences and influences may include a mentor, a hobby, or an interest that propels the individual to explore occupations associated with those elements in their life (Brown, 2002). As students venture through elementary school and through high school, there are factors that influence their future career choices. In fact, students choose careers in college based on five factors in the student's life, such as genetics, environment, instrumental learning experiences, associative learning experiences, and lastly developed skills (Niles & Harris-Bowlsbey, 2012). If their science teachers are educated on CLS and are able to relay this as a viable career option, then students will be able to become aware of the CLS profession as a career.

Krumboltz's career decision-making theory. The Krumboltz theory, which is based on the work of (1994,2009), resulted in a theory that assumes two basic types of learning experiences (Krumboltz, 1994). First, there are useful learning experiences, which "appear when the individual feels successful or is punished, because of certain patterns of behavior and with their connected cognitive capabilities" (Krumboltz, 1994, p. 27). Second, the individual develops an associative learning experience, which "appears when people connect certain emotionally neutral situations with stored emotional situations" (Krumboltz, 1994, p. 29).

The most important career management powers are identity and adaptability (McNeill & Pimentel, 2010). For the realization of a new career, individuals develop new management powers regarding the management of themselves and their career. In addition it has been found, that the new career process "learning becomes more and more stable, and the individuals who learn constantly will be the first to find out how to develop their own new knowledge and adaptability" (Munson, Moskal, Harriger, Lauriski-Karriker, & Heersink, 2011, p. 1845). An individual bases his or her personal career plan on his or her own characteristics, experiences, tasks, knowledge, training, skills, goals, and philosophies. In addition, researchers suggest social learning being an intended focus for career planning to improve the ability of these individuals to make career decisions (McNeill & Pimentel, 2010). For high school students to become aware of CLS opportunities and careers,

Social learning theory. Social learning theory (Bandura, 1986, 2001) focuses on the learning that occurs within a social context. The theory suggests people learn from one another through observational learning, imitation, and modeling. Social psychologist, Bandura, conducted studies to support this hypothesis and proposed behaviors that influenced both the environment and the person. The three core concepts of the social learning theory are people learn through observation, internal mental states are an essential part of the learning process, and learning a new behavior does or does not necessarily lead to a change in existing behavior.

Social learning and the tools that enable individuals to learn from social interactions within organizations align with Bandura's social learning theory, particularly

with description of observational learning and reciprocal determination. Observational learning is the core of Bandura's (1977) social learning theory and describes an individual's ability to learn not just from their own experience, but also vicariously through the experience of others. A four-component process governs observational learning. The four components are intentional processes, retention processes, motor reproduction processes, and motivational processes (Bandura, 1977).

According to Bandura (1977), individual learning behaviors and styles are determined by what degree the learner observes what is being modeled, lived, or has any type of symbolic meaning, or activities going around in a person or community. Retention processes describe how information must be retained. Individuals cannot take influence from what they have observed if they cannot recall it. Motivational processes relate to how an individual distinguishes between acquisition of information and his or her own performance, as well as the motivation that enables an individual to act (Bandura, 1977).

The other aspect of Bandura's (1977) social learning theory is reciprocal determination. Reciprocal determination extends the basic premise that people learn through observation and posits learning involves an interactive play between three components. The three components are the environment, individual behavior, and personal factors (Bandura, 1977). Prior theories attempted to incorporate both personal and environmental determinants, with behavior being an outcome because of the combined influence of personal and environmental determinants. Bandura's treatment of

reciprocal determination positions each determinant as playing an interacting and influencing role bi-directionally.

Bandura (1977) introduced his observational learning theory at a time when technology for learning was not as pervasive as it is today. Straub (2009) suggested in terms of adoption and diffusion of information leveraging technology, social learning theory plays two potential roles. One role is through modeling. Individuals observing others using social media tools may be inclined to also use the tools themselves. The second role pertains to technological advancements in the past few years and accessibility to mass media, modeling, and vicarious learning, which suggests vicarious learning, occurs in the symbolic realm. This concept suggests social learning not only influences the decision whether or not to adopt the technology and tools, but also encourages the exploration of a 3-day workshop to explore the internet on careers in allied health.

Developing a 3-Day Workshop Using Krumboltz's and Bandura's Theories

The two theoretical perspectives that guided the theoretical framework for this project provide practical knowledge to maximize learning in the workshops. Bandura and Krumboltz have identified adult learning behaviors and human development as a reflection of the transformation of learning among adult learners. Bandura (1977, 1986) incorporated personal, contextual, and behavioral input to the career development process and has provided the field with a parsimonious and operationalizable theory upon which to effectively conceptualize career development difficulties and to effectively intervene (Sadler, Sonnert, Hazari, & Tai, 2012).

I incorporated Bandura's social learning theory and the above factors into the development of the 3-day workshop for high school science teachers. The social learning theory builds from Bandura's (1977, 1986) concept of the reciprocal relationship between people, behaviors, and the environment and thereby acknowledges the dynamic and causal interactions that take place between personal factors (i.e., age, gender), environmental influences (i.e., supports and barriers), and actions a person takes within his or her environment (Waight & Khalick, 2011).

Within the person, the theory proposes three main social cognitive variables, including (a) self-efficacy, (b) outcome expectations, and (d) personal goals (Jonassen & Land 2012). Outcome expectations are a person's beliefs about the likely result (or outcome) of their performing a particular behavior (Lankshear & Knobel, 2011). Personal goals include a person's intention to participate in a specific behavior and consider a central aspect of agency leading to behavior (Akers, 2011). Lent, Brown & Hackett (2002) theorized outcome expectations are strongly influenced, causally, by self-efficacy beliefs.

Snyder (2009) theorized people develop career interests because of this interaction, their beliefs in their ability to perform career-related tasks, and their expectations that taking these actions will yield successful outcomes. Both outcome expectations and self-efficacy beliefs in turn influence personal goals. Due to the apparently foundational role of self-efficacy in the SCCT model, it bears a closer look. According to Oja (2011, p. 147),

> If human behavior was regulated solely by external outcomes, people would behave like weathervanes, constantly shifting direction to conform to whatever momentary social influence happened to impinge upon them in actuality, people possess self-reflective and self-reactive capabilities that enable them to exercise some control over their thoughts, feelings, motivation, and actions. (p. 147)

People cannot change their action without paying attention to their own performances, the conditions surrounding their performances, and the outcome. Therefore, success is partly dependent on how close one can self-monitor their actions. Depending on a person's values and the importance of different activities, they tend to ignore those that are not important to them. Self-monitoring is not a simple thing to do. A person's moral and self-beliefs are the influencing factors to which one gives the most attention (Bandura, 1997).

Generally, student career choices continue to change with the presumption that life risks and vocation pathways have any factor or relation to the genuine choice or consequence from social and structural determinants in their path. Social and structural determinants are likewise the premise on which Krumboltz assembled the model of profession choice making, which incorporates three key, related parts, such as logical sane career choice making, interactions with other people who have assets inside the instruction framework, and the course or area where choice makes up the individuals life. To clarify the model of career choice making and these three segments, Krumboltz utilized the idea of habits.

Habit is the arrangement of gained attitudes (from the environment) working on the reasonable level as classifications of discernment and evaluation or as classificatory standards and being the sorting out standards of activity. In this sense, the idea of habit speaks to three truths, additionally considered in their model by Hodkinson, Sparkes, and Hodkinson (1996). First, the development of classifications and recognition are liable to the structural impediments of the individuals in society. Second, the individual's cognitive structure, which is in itself socially organized, because it has a social source. Third, the development of social reality turns into an aggregate actuality (Krumboltz, 1994).

Like locus of control, which also means a theoretical construct designed to assess a person's perceived control over his or her own behavior, researchers theorize self-efficacy occurs in relation to a task or goal in a specific domain (Hans, 2000). Unlike locus of control, the expected outcome does not influence self-efficacy. For example, a person may have an internal locus of control such that they believe success on a test results from their knowledge of the content area; however, they may have low confidence in their ability to gain that knowledge (i.e., low self-efficacy). While researchers believe locus of control is a facet of outcome expectations, they theorize that self-efficacy predicts outcome expectations, a distinct variable in Bandura's (1991) self-efficacy model and in the career-specific model called social cognitive career theory (SCCT).

Interestingly, locus of control might contribute to self-efficacy and outcome expectations in a similar manner, specifically as related to making career decisions. A study showed a moderate correlation between the two constructs, in which external locus

of control correlated positively with low Career Decision and Self- Efficacy (CDSE) and vice versa for internal locus of control (Kwok, 2005). In a later experiment conducted with 60 college students, a videotape intervention aimed at retraining students' attribution style was tested (Wang et al., 2013). The video attempted to persuade students that low CDSE and career decision failure was attributable to lack of effort. Students in the experimental condition who already had an internal locus of control showed no significant differences in CDSE at pretest and posttest. However, students who had an externalizing attribution style at pretest changed to an internalizing attribution style at posttest, and as a result had statistically significant increases in learning through direct CDSE workshop experiences for exploring career options (Neilson et al., 2004).

Learning Through Direct Experiences during Workshops

The field of social learning can attain new patterns of behavior by observing the behavior of other human beings or direct experience, achieved through interactive workshops. The punishing and rewarding consequences followed by any given action mainly governs an elementary form of learning. People are repeatedly confronted with Many types of situations confront people repeatedly. In some cases, they try to produce effective outcomes, and in others, they prove unsuccessful (Laposata, 2004).

A common belief is immediate consequences strengthen the responses automatically and unconsciously. Without having simple general awareness of the relationship between the response and its outcome, even simple performances can be altered to a certain degree through reinforcement (Laposata, 2004). The cognitive skills of man allow him to profit himself extensively from experiences, which differentiate him

from an unthinking organism (Laposata, 2004). Therefore, the primary duty of reinforcement is to provide informative and incentive functions; it also has the capability to strengthen responses.

Reinforcement

In social learning systems, people analyze responses and evaluate differential consequences. Based on these analyzes, different hypotheses and thoughts are developed about the types of behavior which stand out. These thoughts and hypotheses play the role of guidelines for future actions (Laposata, 2004). However, the accurate hypothesis leads to successful performances and erroneous ones give rise to ineffective performances. These differential consequences, accompanied by distally occurring overt behavior, are selectively strengthened or discarded. Researchers suggest motivation is an external reinforcement of learning by experiential analysis and guides the performer about which actions can provide beneficial results or negative outcomes for learning (Laposata, 2004).

Motivational Function

Immediate external reinforcement does not regulate most human behaviors. Based on prior experiences, people expect that certain actions will result in desired outcomes and others will have no effect (Krumboltz, 1994). Therefore, anticipated consequences articulate actions. For instance, most people do not wait for fire to burn their houses down before buying fire insurance; similarly, people who venture outdoors do not wait for torrential rain or a snowstorm to decide what to wear and avoid discomfort. People can also convert future consequences into current motivators that stimulate behavior

much in the same way that actual consequences do. In fact, cognitive skills provide the ability to foresee and to indulge insightful behaviors.

Cognitive Mediation

A study has been developed to verify whether behavior is learned through automatic actions of consequences or if the effects of reinforcement are cognitively mediated. A study has employed verbal conditioning (Laposata, 2004). In these situations, subjects are free to converse and construct sentences; the experimenter appreciates certain classes of words and simply ignores others. The study scrutinizes the changes occurring in reinforced verbalizations because the candidate knew his verbal utterances were reinforced selectively, or that only the type of words he produced recognized reinforcement. According to Laposata (2004), awareness of what is being reinforced a learning model that is necessary for learning.

Learning through Modeling

People develop new responses when mistakes are costly or dangerous by providing competent models without needless errors. These models demonstrate how the activities are to be performed. However, studies can only create a few behaviors complicated in nature to influence the learning models. For example, it would be very difficult to teach a child linguistic skills without giving him an opportunity to hear speech. Undoubtedly, one can never shape intricate individual words or correct grammatical speech through differential reinforcement vocalization. Modeling is an indispensable form of learning, where novel types of behavior can be delivered only

through social cues. In the same way, observational learning is a validated predictor in career decisions for adults.

Observational Learning

Snyder (2009) operationalized career self-efficacy as a predictor of career indecision, and validated and supported this operationalization. Snyder (2009) showed self-efficacy measures related to, yet were distinguishable from, achievements and current vocational interests. The results of this study indicated self-efficacy expectations relate to indices of academic performance behavior or academic outcomes, vocational interests, and perceived career options. Findings from this study confirmed self-efficacy relates to career-relevant behavior, as proposed by Akers (2011) and extended by Lankshear and Knobel (2011). Self-efficacy may be an important factor mediating educational/vocational behaviors of students. This study marks the beginning of a trend that brings together the work of Bandura (1977) and their collaborators into common notions about career psychology (Jonassen & Land, 2012).

The researcher based the development of the program on the theories presented. She carefully considered cooperative learning techniques so the teachers could immediately integrate the CLS profession in their science classes. Based on review of prior studies there is an abundance of literature on the effectiveness of workshop learning that highlights many virtues of cooperative learning. Students are motivated to perform the tasks of the course and to persist in the effort; therefore, for best results, students develop interpersonal skills (communication, teamwork, etc.). Waight and Khalick (2011) believe we cannot equally develop this in a more traditional learning environment.

An additional advantage is cooperative learning provides a versatile repertoire of strategies, some more appropriate for implementing more dynamic classes to focus on STEM development for students and more suitable for organizing small groups of faculty to develop ambitious projects during the course (Waight & Khalick, 2011).

Role and Purpose of Faculty Professional Development-Focus on STEM

When Sadler et al. (2012) characterized the climate of the science, technology, engineering, and mathematics (STEM) disciplines as chilly and unwelcoming, many science faculty members supported the notion, not because it was true and negative, but because was true and appropriate. Science and engineering professors commonly see their role as educators aligned with the production of high-quality graduates and promoting the attrition of weaker students (Waight & Khalick, 2011). Faculty members often consider student withdrawal as a sign of successful instruction; thus, eliminating incapable students unfit for the rigors of scientific inquiry.

The infamous speech commonly delivered during the first lecture in calculus-based physics or organic chemistry courses, instructing students to look to their left and look to their right to identify students who will drop the class, promoted a culture of high standards and high stress that students perceive as ultimately yielding excellent scientists and engineers. Professors proclaimed hard work alone was the key to success (Waight & Khalick,2011). Students failed and dropped out of their discipline regardless of the actions of the educators. Institutions had little impact on persistence.

Unfortunately, educators failed to examine and consider the characteristics of the learners who left the chilly climate. Faculty members were certain that low performing

students dropped out, without analytical evidence. Snyder (2009) was the first to study the exiting group of students, but numerous studies in the decades following their publication have arrived at the same conclusion: high-performing students leave the STEM disciplines as frequently as the underprepared or low performers (Oja, 2011).

Faculty members play a significant role in student persistence in their major (Marques et al., 2011). This research study sought to synthesize and disseminate the factors associated with faculty-student interactions outside of the classroom. Simple instructor actions can improve the faculty-student relationship and increase student persistence in STEM disciplines, raising overall degree attainment (Kwok, 2005).

Attrition from STEM majors is a profound and complex challenge. Despite a national call to increase the number of STEM graduates, less than half of students who begin in a STEM major graduate (Jamieson & Lohmann, 2012). This significant dropout rate is a disservice to students and a challenge for society in general. As educational institutions explore solutions to the STEM retention challenge, numerous studies have concluded faculty members play a critical role in student decisions to leave STEM disciplines. Yet faculty members do not recognize "the critical role they play in a student's decision to persist" (Jamieson & Lohmann, 2012, p. 2). Micari and Pazos (2012) explained, "despite all of the literature-based evidence pointing to the importance of student–faculty interactions in college, that many faculty overlook, or underestimate, the impact they have on their students" (p. 45).

Educational innovation and advancement in teaching methods are readily available in STEM disciplines yet lack a profound impact on students (Jamieson &

Lohmann, 2012). Instead, faculty still base their instruction on their own experiences as teachers and students (Mastascusa, Snyder, & Hoyt, 2011). The lack of a reward system for innovation drives pedagogical change into the "valley of death" (p. 1) without widespread adoption or application. Worse, improvement efforts have been limited to better teaching in the classroom without an exploration into the social side of the student experience (Laposata, 2004).

STEM educators have earned 33% of their degrees abroad, especially from cultures that exhibit a large power distance social dimension, where unwavering instructor honor and respect form the basis of classroom interactions (Marques et al., 2011). Should faculty members mirror their personal cultural experiences in the classrooms of the United States, demonstrating distance from students, learners may interpret the instructor attitudes as aloof and uncaring. The problem is multi-faceted. Faculty members do not connect with STEM students adequately and do not understand the benefits of doing so. Munson et al. (2011) postulated the problem for STEM educators is "that we do not think there is a problem" (p. 1). In addition, faculty perceptions of interpersonal experiences with students do not match students' perceptions (McNeill & Pimentel, 2010). Without an understanding of the importance of the role of faculty members in learner retention, literature suggests educators may unknowingly play a negative role in student success and STEM-degree achievement.

Lessons from the Literature

Research findings support the design of best practices to promote faculty–student connections and professional development in STEM disciplines. Most science-focused

professors can evaluate and respond to evidence-based recommendations (Shieh, 2012). The literature forms an excellent foundation for the development of practical guidelines. However, the paucity of publications exploring the student–professor relationship hinders the availability of compelling evidence for change. Shieh (2012) asked if faculty plays such a, "pivotal role in supporting and retaining STEM students why are there so few studies that seriously explore this variable?" (p. 267). Specifically, it is important to have an inherent sense of professional identity for practitioners in health sciences.

Having an Inherent Sense of Professional Identity

Knowing which laboratory practitioners have an inherent sense of teacher identity might be helpful to managers and program directors when selecting the most motivated and committed individuals for instructional roles. However, laboratory practitioners generally receive teaching responsibilities based on their seniority as professionals. Many health professions education programs rely on laboratory practitioners with little or no teaching experience to function as instructors in the clinical setting.

When selecting individuals for these teaching positions, supervisors use longevity as practitioners as one criterion, and supervisors assume teaching skills have developed along with technical skills (Jonassen & Land, 2012). Rarely do these individuals have any formalized teacher preparation; therefore, they may not be fully aware of what the profession considers appropriate pedagogy. In my study, only five of 13 clinical instructors had any formal training for their teaching roles. This lack of training may become problematic when instructing students of health professions whose educational needs are typically diverse.

The first four assumptions of establishing professional identity include self-concepts of autonomy and self-direction, the role of the learner's life experience, and the readiness of an adult to learn, and the orientation to learning. The last two assumptions were later added to Lankshear and Knobel's (2011) model. Lankshear and Knobel's (2011) model encompasses the internal learning motivators of adult learners and the rationale adults need to have to understand a new learning task before it is undertaken. An original set of six assumptions were further revised and refined to become the core adult learning principles of the andragogy in practice model. Lankshear and Knobel (2011) conceptual framework applies andragogy as a changing nature of the field across multiple domains of adult learning to include, "goals and purposes for learning, individual and situational differences of learners, and core learning principles of andragogy" (p. 5).

Changing Nature of the Field

CLS education programs now rely on laboratory practitioners with little or no teaching experience to function as instructors in the clinical setting and facilitate training that accounts for approximately half of the professional coursework (McNeill & Pimentel, 2010). When selecting individuals for these teaching positions, longevity as practitioners is often the criterion used, and many assume that teaching skills have developed along with technical skills. The clinical instructor role is rigorous and includes such functions as teaching, supervising, evaluating students, and role modeling. This unique position requires practitioners who are able to provide quality healthcare and simultaneously support student instruction.

Not all laboratory practitioners are willing to accept this challenge. Furthermore, the satisfaction levels of individuals who do agree to serve in instructional capacities may be impacted by their identification with the teaching role. Because clinical instruction is vital in maintaining the quality of the medical laboratory science workforce, ideally individuals who provide this instruction should be committed to the profession and have an interest in teaching (McNeill & Pimentel, 2010). Collaboration with clinical practicum sites can reveal many investigative, practical projects the clinical laboratory has had to delay or eliminate due to staffing shortages or time constraints. For example, students can also work with staff in the laboratory to perform studies for validation of a new instrument or method under implementation. The performance of the necessary studies and the evaluation of statistical data will reinforce the information learned in method evaluation and the analytical phase of testing (McNeill & Pimentel, 2010). These projects reinforce pre analytical, analytical, and post analytical issues with the generation of data and specific solutions evidenced by this clinical research.

Students, working with mentors at the university and clinical practicum sites, can relate results achieved to their application in clinical laboratory practice. Such correlations can directly and indirectly affect the quality of laboratory testing, quality of health care, and improved patient outcomes (McNeill & Pimentel, 2010). Evidence from clinical research projects developed by clinical and university mentors with their students can provide new processes and protocols to improve health care delivery by the laboratory (McNeill & Pimentel, 2010). Students can actively participate in clinical research, where they will develop research skills to use in their future capacity as medical

laboratory scientists. Of course, clinical studies will aid students' understanding in using the results of their studies to develop analysis and assessment of current and new methodologies, instrument comparisons, and clinical practice processes.

Student Perceptions of Faculty Members

Several quantitative studies offer information linking student performance and perceptions of positive faculty connections. Researchers have found an association between students' positive feelings and learner academic confidence, self-efficacy, grade point average, and retention can guide educators to understand these connections to perception of faculty members. Akers (2011) study offers quantitative evidence that faculty have the ability to affect student performance, and thus his or her persistence.

Lankshear and Knobel (2011) documented a correlation between a student's grades in organic chemistry with the feelings of the learner regarding the connection to his or her professor. Three qualities comprised a positive relationship: approachability, respect for students, and the faculty as a role model. Lankshear and Knobel (2011) also found a strong student-perceived relationship with the instructor increased the student's confidence in course success. Snyder (2009) also documented the connection between academic success (as defined by grade point average) and positive feelings toward faculty members. To improve the student-professor relationship, Snyder documented the importance of faculty members making themselves available to students.

Oja (2011) conducted a qualitative study to explore the role of faculty in retaining STEM students. When interviewing students, Oja identified a common theme, the absence of any positive relationships with faculty members. Students described their

professors as insensitive to their learning and personal needs. Students described feeling humiliated and insulted, promoting an antagonistic long-term relationship. In contrast, students also identified a few professors who displayed caring qualities, such as engaging in conversations outside of class, providing support during challenging situations, or expressing concern about their professional future.

Marques et al. (2011) studied persistence for engineering students and found perceptions about faculty behaviors correlated with grades in challenging courses. Students reported they "felt that the professors were intentionally making courses difficult in order to weed out students" (p. 230). Students described feeling as if they were in a "mental battle" with the academic program and those who persisted described refusing to break down, saying, "I often felt that it was the survival of the fittest" (p. 231).

CDSE has been the subject of over 400 research studies in vocational psychology because of its importance in young adults' career development process and its high rate of modifiability. Extending the CDSE research base beyond the search for direct effects, Corbin and Strauss (2014) revealed specific components that effective interventions commonly contain. These critical treatment ingredients include workbooks and written exercise, individualized interpretations and feedback, world of work information, modeling, and attention to building support (Munson et al., 2011). Their work revealed effect sizes increase with the use of up to three of these components regardless of intervention type (individual or group counseling, workshop, or course); thus, implying

that including any combination of up to three of these components significantly increases the effectiveness of career decision interventions.

Institutional Interventions

Seeking to connect faculty and students purposefully, institutions may offer programs to initiate contact that could prove beneficial to student retention and success. Faculty mentoring programs may focus on general support or discipline specific connections in the laboratory to assist students prior to terminating their enrollment in the CLS program. Currently, professors who mentor undergraduate students often link professional practice and hands-on experience through research opportunities.

Mentoring. Academic programs have established mentoring programs to promote close connections between faculty members and students. STEM disciplines may lack strong support or widespread usage of this approach to student engagement (McNeill & Pimentel, 2010). Mentoring can promote personal motivation, develop feelings of encouragement toward academic success, and encourage discipline-specific connections. According to McNeill and Pimentel (2010), STEM disciplines are prepared to address concerns and recommended each freshman student connect with a faculty mentor to promote relationships and to ensure students train in the laboratory sections. Upper division students may be useful as peer mentors and may serve as a supplement to faculty connections; peer mentors can offer freshman students more immediate help when faculty members are less available (Shieh, 2012).

Sadler et al. (2012) described mentoring engineering students as an “offer of friendship as a part of the professorial role” (p. 408). They encouraged institutions to

train faculty members to be excellent mentors, reward them, and recognize their efforts. Student feedback should guide the relationship and enhance future experiences. In addition, Waight and Khalick (2011) explained not every undergraduate professor could be an effective mentor: "Mentoring does not come from a guidebook; a set of rules, or even incentives, mentoring comes from the heart" (p. 410).

Undergraduate research. Institutions have sought to improve the faculty-student relationship through undergraduate research experiences. The National Science Foundation and several other agencies provide funding to support initiatives that organize learning opportunities for undergraduate STEM students within the research laboratory (Jonassen & Land, 2012). The apprenticeship experiences offer learners the opportunity to collaborate with scientists, post-doctoral researchers, laboratory scientists, and faculty. The undergraduate students design experimental protocols, collect and analyze data, and "apply classroom knowledge to real world problems" (p. 27). Through undergraduate scientific research experiences, learners have the opportunity to make close faculty connections. Preliminary program evaluation results suggested improved retention and persistence in the STEM disciplines (Jonassen & Land, 2012).

Lankshear and Knobel (2011) published a list of 12 risk factors associated with student attrition in college. Adapting these findings to sort intrinsic and external concerns can offer faculty members a greater understanding of their role in student success. Faculty members may directly influence factors including academic goals, connections to campus environments, coursework interest, adapting to the college student role, finances, and academic knowledge. In spite of, faculty-student-centric factors may be more

difficult for faculty members to cultivate and develop, including ethical judgment, psychological issues, ability to delay gratification, self-regulatory skills, self-efficacy and resilience, and flexibility (Lankshear & Knobel, 2011).

Professional Development Based on Faculty-Student Engagement

Although some disciplines are effective in the creation of a culture of faculty–student engagement, many of the STEM disciplines rely on highly recognized researchers as instructors who often lack deep connections with students (Akers, 2011). The culture of STEM education diminishes the importance of the professor–student relationship, shifting focus to the creation of new knowledge through research. Snyder (2009) described student-reported feelings of humiliation by professors, suggesting professors "just did not care about teaching [students] even though students were serious about learning and were willing to put forth effort" (p. 9). Many STEM programs lack the knowledge, tools, or administrative support to alter the prevailing lack of caring.

Oja (2011) called for a movement to include faculty members in retention efforts, suggesting, "Faculty members and their role is critical, and they seem to be much more open to talking about how we might improve things" (p. 6). The long-standing conflict between the institutional goals of research and teaching may contribute to the diminished professor–student relationship in STEM disciplines. Institutions seeking to increase their STEM retention and graduation rates may need to promote improved awareness of the role of faculty members in this mission.

Shifting professors from a culture of encouraging attrition and promoting an environment in which only the top students succeed into a caring and nurturing culture

takes effort and specific action ideas. Examination of the characteristics of positive one-on-one relationships can promote faculty member perspectives that may result in caring relationships. Marques et al. (2011) developed a rapport scale that could offer quantifiable evidence should it be implemented. The qualities examined in the survey instrument characterize the optimal student-professor connection, exploring instructor qualities and behaviors. Some positive faculty member qualities included in the scale are thoughtful, enthusiastic, respectful, understandable, eager, compassionate, fair, reliable, confident, helpful, and friendly (Marques, et al. 2011). Actions that promote rapport included being available via e-mail, encouraging class discussions, going over material if students are struggling, providing examples, encouraging questions, setting clear expectations, and being approachable during office hours.

A person's cognitive processing of their experiences determines how much and what type of conclusion they will draw, therefore influencing their future ability to succeed. For example, a student who interprets a high grade because of the hours she put into studying for a test is more likely to have higher test-taking self-efficacy than a student who did not study and still received a high grade. This example emphasizes the distinction between self-efficacy and the construct of locus of control.

The example also reinforces the important point that experiences contributing to self-efficacy do not do so equally for all people across the board; rather, a learner's efficacy (LE) influence depends upon how the individual cognitively perceives the experience. In other words, there are individual differences in the effects of Learning Efficacy (LE), which is another reason why having a standardized way to measure them

is appropriate and will contribute to the development of interventions and the robustness of career decision-making research (Waight & Khalick, 2011).

A common component of interventions that focus on career decision making includes the opportunity for students to attempt and succeed at career-related tasks, capitalizing on the contribution of performance accomplishments to students' career-related self-efficacy. For instance, in career courses and individual counseling settings, young adults may practice interviewing and take part in experiential learning activities that may include volunteering in a field of interest, joining an organization related to their field of interest, and job shadowing (Lankshear & Knobel, 2011). After participating in such experiences, talk therapy and self-reflective written exercises may help them integrate and apply the experiences to their career decision-making process.

An understanding of Bandura's social learning theory (1977) and Krumboltz's career choice theory (1994) is important for the learner's knowledge of career opportunities for adults. Both theorists' concepts appear into the development of the 3-day workshop for high school science teachers. Professional development and mentoring of students will broaden the learner's scope of knowledge and perceptions of career choices. Students have to choose their career path and their identity in society. Many students who enjoy science, technology, engineering, and mathematics (STEM) will venture towards those careers, and others will choose other paths to explore. However, data shows students who are not aware of certain career choices because of lack of exposure or communication will not enroll in CLS and or other allied health professions. For that matter, it is important to incorporate faculty professional development and career

self-efficacy to decrease the gap of students being aware of STEM career choices and opportunities.

Implementation

As outlined in the literature review in Section 1 and the study research outcomes, high school science teachers have different degrees of awareness of the CLS profession in the local high school setting. A professional-development project was created to inform high school science teachers of the importance of the CLS profession and the value of CLS for the medical profession. Science teachers' awareness of the CLS profession will potentially influence the enrollment of high school students in a major in college and possibly prevent the shortages of CLS positions. Therefore, the implementation plan of the proposed project is divided into four segments that describe the resources, the support systems and barriers, a proposal for implementation, and the roles and responsibilities required of the high school administrator.

Needed Resources and Existing Supports

As is the case with most local professional-development programs, the policymakers are responsible for funding the support for faculty development workshops. The hope is that the local board might realize the importance of this program and find some creative funding processes for this endeavor. Before progam planning can occur, resources to support the program and societal needs should be evaluated (Caffarella, 2010). Approval from the high school district offices to develop the seminar could possibly comprise the program planner's time to develop, revise the workshop curriculum and time to prepare the classroom for teaching and time to facilitate the program. Time

allotments may vary depending upon feedback from the first day formative and summative evaluations. Time also needs to be considered for the facilitator to prepare the auditorium for the workshop and the facilitating of the workshop. In addition, involving district office superintendent is always an avenue worthwhile to ensure programs can be funded for other necesssary resources. These materials will include program advertising to science teachers, program instruction materials, program evaluation handouts to be complete by administrator, large pades, markers, computers, and projectors. Lastly, a conference room or auditorium will need to be reserved for the 3-day program.

The resources needed to facilitate the program exist in the local high school district. Existing supports include rooms in the high school and district offices available for reservation. Furthermore, the principal of the high school district has committed to support this program as part of the professional-development training series for science educators. The district office has implemented policies that allow science educators 2-3 days for professional STEM career development training. There are district budgets to support the purchasing of training supplies needed to facilitate professional-development programs for science educators. The feasibility of facilitating this professional-development workshop is completely supported by the local system to approve school districts' science courses (Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2010). However, the potential barriers and potential solutions are also discussed for the implementation of the workshop for high school science teachers.

Potential Barriers and Potential Solutions

Potential barriers to implement the program vary and may include program design, coordination, and informational barriers. Potential barriers to implementation of the program could also be due to instructor time constraints, participant time, budgetary restrictions, and evaluation completion of program. The definition of these barriers depends on the program execution interface. In addition, time, resources and understanding of the program may also obstruct the implementation, which may prove problematic for a high school science teacher who has limited knowledge and resources of the laboratory science profession. Professional development, facilitation, and evaluation require adequate time and training for science teachers to be effective in learning strategies for assessment of student learning in science class (Hanauer & Bauerle, 2012). Science educators' potential barriers may include lack of interest in program to make them aware to communicate effectively the CLS profession to high school students, time to incorporate the workshop curriculum into teaching practices in their perspective science course, and time to evaluate for transfer of learning. Some educators may not find the program meaningful, which in itself may become a potential barrier, as they may not attend and engage in the workshops learning process if the program is not meaningful to them personally (Caffarella, 2010). Lastly, ensuring district support is an important factor to the implementation of the program, and if this support is lacking it could have a negative impact on the development of the program. Moreover, Stakeholders, including administrators and district-level decision-makers, support fiscal

and facilities resources. Therefore, a lack of fiscal and facilities resource support may impede the implementation and timetable of educational program offerings.

Proposal for Implementation and Timetable

The facilitator will implement the 3-day professional-development workshop annually for all new and existing science teachers as part of the high school professional-development workshop series. Participation will be open to all science educators employed in the community high school district. The implementation time line will begin with a needs assessment that the facilitator will distribute to the teachers two weeks prior to the professional-development workshop. The program coordinator will instruct teachers to return the needs assessment to the facilitator one week prior to workshop. This process will allow ample time for the facilitator to adjust workshop learning experiences and activities based upon the learning/needs and preferences of participants.

The structure for the learning experiences and the development of the curriculum for the professional-development program follow Tyler's model of curriculum development and Bloom's taxonomy of educational objectives (Huitt, 2009). The program coordinator will implement the workshop over 3 days. There will be two sessions for the science teachers: one for new teachers as part of their teacher orientation and another session for experienced science teachers in the high school. The professional-development workshop sessions will last 8 hours for all 3 days. During the last 2 hours of each day, the teachers will take part in formative evaluation, and at the completion of the workshop, they will receive a summative evaluation to complete.

To evaluate for learning transfer, the facilitator will assess the teachers 6 and 9 months after the workshop. Facilitators will observe the science teachers' classrooms and evaluate whether teachers are utilizing CLS awareness and communication of the allied health profession to encourage students to enroll in CLS in college. The facilitator will send the evaluation results to the teachers, the high school principal, and other stakeholders; thus, serving as a secondary summative evaluation of the program. The facilitator will revise the workshop for future sessions using the evaluation findings from the teachers' observational evaluation. To summarize, Table 7 in Appendix A displays the proposed implementation timeline of the roles and responsibilities of students and others for the workshop.

Roles and Responsibilities of Students and Others

There are clear, defined roles for teachers, facilitators, the high school principal, and key stakeholders. Key stakeholders include the principal, university CLS directors, the hospital laboratory director, the hospital vice president, and CLS professionals. The principal must commit to fiscal and organizational support for the program for science teachers. The high school science teachers have the responsibility to inform the facilitator of learning needs, whereas program facilitators have the responsibility of making sure they, and the teachers meet course objectives. The facilitator also develops needs and preferences into workshop content and curriculum goals. Teachers and facilitators both have the responsibility to engage in the learning process, and science teachers are obligated to incorporate this new knowledge and awareness of the CLS profession into their science course. In addition, the facilitator must develop curriculum that is

meaningful to learners to maximize the students' chances of enrolling in an accredited CLS program in college.

Curriculum Definition and Development

Curriculum is the process of knowing what to teach and providing ways to teach with specific goals and objectives. According to Hale and Dunlap (2012), curriculum aims at intentional learning of a course of study. According to *Dictionary.com* (2012), "Curriculum is the course of study in a given school, college, university, etc." (n.p.). Curriculum should entail a set of goals that teachers and students can achieve through a developmental process concluding in a successful student learning outcomes (Coenders, Terlouw, Dijkstra & Pieters, 2010). A curriculum developer not only identifies the content to deliver, but also who establishes the learning objectives of students. Curriculum can assist in the learning outcomes by identifying the workshop content, assessing of student learning, and goals of the learners.

Through the process of curriculum delivery, learners can transform if the curriculum has been developed and planned suitably. According to Hale and Dunlap (2012), appropriate planning of the curriculum for the workshop includes, but is not limited to, what is intended by the designers (planned curriculum), what is organized by administrators, what is taught by the teachers (delivered curriculum), and what is learned by the students (experienced curriculum)" (p. 297). Effective development planning is derived from knowing the content, knowing the intended student population, providing various learning experiences and diverse measures to accomplish the curriculum goals,

and knowing ways to assess student outcomes effectively. Curriculum is the blueprint for learning.

Curriculum development is the process of reaching academic goals and expectations, knowing the ways to design and teach the program, ways to distribute the information and means to reinforce concepts within the classroom setting, and ways to evaluate learning outcomes. The development of curriculum also demonstrates to administrators their schools' changing needs, incorporate emerging technologies, and reflect new and creative ways of thinking about education to lead to excellent student achievement (Myers & Berkowicz, 2015). By developing a curriculum, teachers must identify the appropriate measures needed to ensure positive student learning is occurring. Myers and Berkowicz (2015) stated, "Curriculum development in science, technology, engineering, and mathematics is a process and cannot begin until the vision or depiction is present" (p. 75). The intent of any curriculum should be student achievement and understanding, as well as meeting other needs identified in the preliminary needs assessment process.

Curriculum Components

The following components have been included in the curriculum for the 3-day workshop: (a) learning outcomes, (b) outcome of course content, (c) materials and resources, and (d) various instructional activities to address the needs of all learners' objectives, and program evaluation. Curriculum objectives listed for the 3-days of the workshop enable the program developer to set career-awareness and career-development goals that the science teachers will have as goals and objectives. In the 3-day

professional-development workshop for high school science teachers, an example of instructional activities is collaboration with fellow science teachers on Internet exercises focusing on career exploration. Collaborative instructional activities focused on exploring different science careers, enhancing teacher career awareness of academic programs offering CLS programs, and instructional strategies that inform their science curricula to introduce students to the CLS profession. The facilitator provided formative evaluations throughout the training on a daily basis as these evaluations enable the facilitator to determine whether the science teachers are learning the workshop material and whether they are meeting the goals and learning objectives.

The participants will complete a summative evaluation at the conclusion of the workshop. By providing the summative evaluation, the program designer will have evidence that the participants either are learning the desired material on the awareness of CLS profession to high school students or need more instruction and collaboration on the career-awareness theories, awareness of the CLS profession, and exposure of the CLS profession. Administrators, teachers, and the program coordinator can use these results to inform future iterations of the workshop. Program facilitators evaluate whether the design and delivery of a program were effective and measure whether the defined program objectives and outcomes were met (Royse, Thyer, & Padgett, 2014). Effective evaluation procedures are to examine the process of the 3-day workshop and to determine what is working and what is not working. Formative evaluation is to monitor the usefulness of the workshop and focus on the process, whereas summative evaluation measures the final activities and outcome of the 3-day workshop (Royse et al., 2014). Specifically, the

facilitator can use the formative evaluation data to improve the design, delivery, management, and evaluation of program activities while in progress. Moreover, evaluation data may guide decision making for future programs of a similar nature or identify needs for future programs.

Student Learning

Students can learn more willingly when teachers use a variety of instructional techniques. Hale and Dunlap (2012) found the methods instructors use in the classroom enable and enhance the learning processes. Hale and Dunlap also noted student learning improves when instructors use a collaborative approach in the classroom when teaching adults.

By incorporating a variety of instructional methods, the program developer can help science teachers to obtain an understanding of the 3-day workshop and to ensure the best formative and evaluation needs are met for the teachers. Best practices of career education are the use of techniques and strategies that enhance student learning of the CLS profession. Best practices can include, but not be limited to, hands-on-activities-internet exercises, career exploration and assessment activities, career and education planning worksheet, job values inventory exercise, lastly the introduction to students of CLS profession, educational requirements of a CLS, and careers in CLS (Hale & Dunlap, 2012, p. 47). Hale and Dunlap (2012) defined best practices as collaborative, rigorous, inquiry-based, and challenging. Therefore, the learning activities of the training workshop will include consideration of best practices to enhance and enrich the science teachers' instructional strategies with their students.

Summary

The researcher conducted a literature review in order to inform theory and best practices related to implementation of a 3-day professional-development workshop. In the literature, the researcher identified themes in relation to RQ1, which included they believe CLS professionals draw blood, perform surgery, run tests, and that several high school students simply do not know what CLS professionals entail. The themes mentioned regarding RQ2, which provided direction to the development of the 3-day workshop and literature review, were that college students enrolled in a CLS profession because of interest in science, their own investigation made them interested in the CLS profession, they desired a job in healthcare, and they had family members in healthcare. There were negative themes in response to RQ3, such as people do not know what CLS professionals do, they have low salaries compared to nursing, there is a lack of career growth and development, and an increased workload due to physicians ordering more lab tests. The positive themes were the individuals' love for science, the field being in high demand for employment, an enjoyment of science labs in college, and overall interesting work. The researcher utilized these themes to shape the development of the 3-day professional workshop and the review of literature for this project.

The two theoretical perspectives of Bandura (2011) and Krumboltz (1994) guided the project's development of learning objectives and outcomes. The researcher incorporated of Bandura's (2012) social learning theory and social cognitive career theory (1977) into the workshop for science teachers. The inclusion of these theories affirms the fact people learn through experience and observation. By highlighting the

importance of learning components in the environment, individual factors, and human development, the science teachers can learn what factors influence a person's career choice and professional path. For example, the STEM development arises from students having a desire to learn science, technology, engineering, and mathematics. STEM students may be the student to attract that may choose a field in CLS. Krumboltz's (1994) theory focuses on a student's choice of career and vocational paths due to social and structural determinants. The model of professional choice includes an individual's interactions with other people, individual personal life goals, and sane career choice making. Krumboltz's (1994) career choice theory utilizes the idea of habits, attitudes, and impediments. Attitudes that emerged from can promote an environment or structural impediments of individuals in society. The researcher used Krumboltz's career choice theory in the development of the workshop by unifying social cognitive theory of career and academic interests of allied health professions, choice, and performance in choosing a career path.

The focus of the literature review was on identifying resources for developing a workshop that would attract high school students to enroll in a CLS program in college. The results of the literature review showed by developing a 3-day workshop for high school science teachers, the goal of this study could be achieved. The teachers' new knowledge and understanding about career development may aid them in their science courses in hopes of increasing student awareness of the CLS profession. The researcher anticipates science students who are enthusiastic about science, technology, engineering,

and math are more likely to engage in active learning addressing the career options in the CLS profession.

Project Evaluation

Project development and evaluation are ongoing processes. Project development, when created and guided by the tenets of career choice and social cognitive career theory (Sheu et al., 2010) requires a commitment of both time and attention to detail. The science teachers will take part in a 3-day workshop to develop the awareness of CLS profession to high school students and to attract high school students to enroll in CLS programs. The program planner has to assess critically the development of the 3-day workshop if the goal of the program is to promote the CLS profession to high school science teachers. Rather, project development begins with collaborative goal setting and continues to evolve via collaborative curriculum decision-making, interactive teaching tactics, and collaborative evaluation practices the facilitator must work with teachers for the success of the workshop.

After completing the 3-day workshop project, the anticipated next steps would be determined via teacher feedback, including formative and summative evaluations from the workshop, and quarterly evaluations of science teachers' classes. The National Staff Development Council (NSDC) recommends that only after specifying the outcomes can facilitators reasonably determine the kinds of professional learning necessary to achieve the intended learner outcomes for students (Killon & Roy, 2009). Specifically, evaluation includes core measurement criteria. Alignment of goals is imperative if knowledge gained is to transfer and become acculturated into curriculum of the high school science

teachers. The criteria include planning, teachers' perceptions of professional development, and the intended outcomes. The NSDC also recommends teachers are involved in collecting data on professional-development outcomes and indicators (Killon & Roy, 2009). Subsequently, evaluation results will be shared with all key stakeholders to help inform all administrative decisions. Because of this project study, I have learned how to develop and most importantly, evaluate a 3-day workshop that fosters career choice theory.

Overall Performance Measures

The overall performance measures of the 3-day professional-development training will be formative and summative evaluations of the training and facilitator evaluations of teachers' classrooms post training. The program designer will provide formative evaluations to the science teachers at the conclusion of day one, day two, and day three of the workshop for them to complete and return to the workshop planner. However, the program planner will provide summative evaluations to the science teachers on the last day of the workshop, and to the program planner. The program planner will distribute formative evaluations daily to students during the last 2 hours of instruction. The information from the formative evaluations will offer the trainer the opportunity to make any needed adjustments in the training workshop. The program planner will distribute summative evaluations on the last day of the workshop to determine general workshop efficacy and achievement of learning outcomes. To facilitate the classroom teacher evaluations, the program planner will develop a checklist of core CLS awareness concepts at the end of workshop by participants in conjunction with the program

facilitator. This list will serve as the checklist that a facilitator will use to evaluate students' awareness of the CLS profession at the timed interval of six and nine months after the conclusion of the workshop.

Implications and Social Change

Local Community

The social changes implicated in this project are unlimited. Most high schools and organizations use professional-development programs as a tool to train and to familiarize new employees with the skills and knowledge needed for goal attainment and professional success. Not only does this project provide criteria for the professional-development program for the high school science teachers under study, it also provides other schools, other districts and other business sectors with significant information to implement professional-development programs or to improve existing programs for student awareness CLS allied health profesions. In particular, principals, laboratory administrators, hospital administrators, students, CLS professionals, and the teachers will benefit from this program being developed and implemented. Meeting the needs of each group outlined in this section will contribute to significant social changes for the local community overall as the medical needs of an againg community of baby boomers will be provided for in an effective manner. The potential shortage of CLS staff and clinicals will be addressed through the implemenatation of the project. The expansion of student career awareness of CLS careers will hopefully result in more students opting for degree programs in this field. More graduates of CLS programs means more qualified professionals to serve the medical community.

Far-Reaching

Before deciding on a topic for this project, I contacted a local hospital with a shortage of laboratory scientists, a local high school science class, and an accredited CLS program at a college in the community. I learned no one at these institutions had any suggestions on how to improve the awareness of and commuication about the CLS careers for high school students. By conducting this study and designing the workshop on awareness of the CLS careers, I can possibly contribute to a potential increase the body of knowledge on career development, as well as in the number of student enrollment in CLS in the college. Other school districts, allied health facilities and possibly other industries that utilize laboratory scientists in the workforce might benefit from this project.

Conclusion

The purpose of this study was to explore high school students' understanding and perceptions of allied health professions, the factors that influence college students in CLS-related programs and CLS professionals to select CLS as a profession, and the anticipated consequences if the industry does not adequately address the shortage. The researcher used a qualitative research methodology in this study, and conducted individual interviews and focus groups with high school students, and college students enrolled in CLS programs and practicing CLS professionals.

The researcher conducted qualitative analysis of interview data to answer the research questions. The findings of the study guided the development of a 3-day professional-development workshop designed for high school science teachers. The goal of the professional-development workshop was to provide high school science teachers

the knowledge, skills and expertise necessary to integrate greater awareness of CLS career fields into their existing instruction. By communicating to the students the knowledge of the profession prior to entering college, teachers could enhance and increase the potential of students selecting an accredited CLS college program of study. The implementation of the workshop promotes the subsequent integration of CLS principles into science education courses and intends to enhance students' awareness of and interest in CLS-related fields. Ultimately, this interest could translate into higher enrollment in CLS postsecondary programs and professions.

Section 3 introduced the proposed project, the goals of the project, and the literature to support the project. The researcher provided a thorough description of project resources, roles, and responsibilities. In addition, the researcher presented the project evaluation and implications for social change in Section 4. Additionally, the researcher also presented final project reflections, conclusions, and recommendations about the project study. The project is located in Appendix A.

Section 4: Reflections and Conclusions

The purpose of this project was to design a 3-day professional workshop for high school science teachers as a strategy to increase students' awareness of CLS careers. To determine the design and development for the program, I collected and analyzed data from individual interviews with CLS professionals and focus-group sessions with high school and college students. I reviewed the literature on career decisions and faculty development. I also saw themes that were similar to the results in the literature for the project study. Some of the themes that were coded mentioned that CLS professionals perform surgery, run tests, and draw blood, while some high school students mentioned they just do not know what CLS do in the profession. Other themes that provided guidance to the development of the 3-day workshop and literature review were college students enrolled in a CLS profession because of interest in science, students' investigation of the CLS profession, job in health care and family members in health care. The other themes that influenced the development of the 3-day workshop were positive and negative themes from questions asked to CLS professionals regarding their longevity in the profession. The positive themes reflected the individuals love for science, the field in high demand for employment, the enjoyment of science labs in college, and interesting work. There were negative themes, such as people do not know what CLS do, lower salaries compared to nursing, lack of career growth and development, and workload increases due to physicians ordering more lab tests. The final section of the project study includes a discussion of the project strengths, limitations, and recommendations of the research findings and proposed project. This section includes an analysis of my personal

scholarship, project development, and leadership attributes. It also contains a reflection of the project study, including its implications, applications, and recommendations for future research.

Project Strengths

My personal interest and research established a need to develop an effective professional-development program to increase science teachers' awareness of the CLS profession. To address this need, I proposed a professional-development program based on career exploration skills and related literature as defined in this project. To establish the strengths of this project, I explored the literature and the data analysis and findings. This project serves as a road map for strengthening professional development and awareness of the high school science teachers and students for CLS profession.

The increase in baby boomers retiring from the CLS profession has become a topic of interest and concern for hospitals and college administrators (Kaplan & Burgess, 2011). The findings from this study indicated clinical laboratory practitioners rarely received any guidance or mentoring as they entered the profession. In addition, my knowledge and experience as a CLS in hospitals, a laboratory supervisor, and a college educator added strength to the project.

Recommendations for Remediation of Limitations

The main limitation in the study was the fact the project had not been adopted officially by the high school for which it was planned. The high school administrator had not adopted the 3-day professional workshop into the science teacher's evaluation because the workshop was not been finalized by the facilitator to propose at the time. The

project, developed in response to the study's findings, focused on the professional development for high school science teachers. I recommended involvement with college educators and college students to develop their awareness of the CLS profession further. I have also made suggestions that will address resource allocation, costs, and time for the faculty-development workshop and implementation.

To address the time factor, I suggested the workshop take place five days before school begins for all existing high school science teachers, and the school could hold future iterations of the workshop during new-teacher orientation. Further, I suggested the principal review the 3-day professional-development workshop via the instructor learning modules on the school website. If the high school administrator adopts the 3-day workshop, the professional-development workshop will be available on the school website for the first year. The cost of paying an instructor to keep the workshop materials and the online modules up to date will have budget implications that will make the superintendent unlikely to approve the project. To address this issue, the 3-day workshop could also be done via Skype or other technology tools, saving budget hours for time and other expenses for the school district.

As an alternative to addressing this type of challenge, the new high school science teachers can enroll in or attend similar faculty awareness workshops at other schools outside the district. The science teachers may have nominal fees to attend the outside workshop at other high schools. School districts may provide limited monetary reimbursement for the workshop if taken at another school. However, some teachers might consider the cost a barrier and might not attend. The primary challenge in the

project is although I have the information for developing career awareness at the local high school; I do not have the support and advocacy from other high school administrators or other stakeholders to make this 3-day workshop on the CLS profession an optional experience for all high school science educators in the district.

Scholarship

Scholarship enhances and promotes a higher level of thinking and understanding (Evans, Forney, Guido, Patton, & Rennet, 2009). As I embarked on a pursuit of a doctoral degree, I had no understanding of the work, research, and commitment it would take to complete the degree. I was excited about finally having the opportunity to achieve a lifelong goal. Scholarship relates to the analysis of teaching, learning, and the possibility of transforming knowledge and bringing it into the environment (Hutchings, 2011), and now I can consider myself a scholar.

Through this process, I have developed a sense of professional growth in the field. The scholarship of teaching and learning has affected my perspective as a scholar, from the beginning of my doctoral journey and as I move closer to the end. I realized early in the process that my expertise was limited, and I had to expand my scholarly knowledge. I was astonished at the number of articles I have read and the numerous scholastic search engines I have used in this investigation.

I have learned to improve search strategies for the particular subject and topic. I have developed academically, and I have a broader understanding of research methods and analysis tools to address any academic problem I may encounter or choose to study. I feel more confident in empowering my colleagues through my scholarship. I feel I can

advance my practice by maintaining an up-to-date knowledge of current research and studies. My position as a researcher, and the way I present my research findings reflects who I am and who I have become as a scholar.

Project Development and Evaluation

Being an educator for 12 years, a CLS for 15 years, and a developer for allied health programs for 5 years, I have observed the many obstacles of developing programs. It was not until the development of this project that I saw the challenges of building a comprehensive workshop for educators. During the process of implementing my doctoral study, I found myself faced with planning a 3-day workshop for the community high school in the Chicago area. What I learned about the project development is the planning and completed project is similar to the creation of a science project in elementary school.

The professional project workshop began with an idea and included processing the project, finishing the project, and educating others about the project. Drawing from Bloom's (2009) taxonomy of cognitive learning and teaching outcomes, I was able to design and develop an effective program. Project development required a commitment of time, attention, and interest to be successful. Developing a workshop took time and patience. Workshop planning began with the initial problem and continued to evolve with objectives, course materials, learning activities, products, and evaluation methodologies.

Workshop planners should consider the organization's mission, goals, and the purpose of the workshop during the planning. Alignment of goals is important to ensure knowledge occurs and the transformation of learning becomes everyday practice for the learner in pursuit of the organization's mission. Because of this project study, I have

learned how to design, develop, deliver, and evaluate a career-awareness professional-development workshop for science teachers. At the completion of the workshop, a summative evaluation is an important tool to address the effectiveness of the 3-day workshop for science teachers (Vella, 2010).

Leadership and Change

As I progressed through this qualitative phenomenological study and project, I learned while leadership promotes change in any educational setting, educators, especially those with years of experience, do not easily accept change. Resistance among experienced educators is the initial response, but if one or more faculty members are convinced the career-awareness program is worthwhile, other educators are likely to accept the change. Presenting educators with the study results is likely to increase their knowledge of the problem and the importance of the project. The sharing of findings will promote advocacy to increase science teachers' involvement in the 3-day workshop. The buy-in of the high school principal was important for the project because the high school principal is a senior leader who supported this project. Many of the science educators saw this project as a valid opportunity and considered possibly adopting the program in the high school.

Analysis of Self as Scholar

The findings of the study were presented using existing literature and were compared to similar studies. I had difficulty considering myself a scholar in the beginning of the study because I had not done extensive research, but as I applied what I learned, I became more comfortable in the role of scholar. Scholarship is a lifelong journey and

takes continuous revisions, reviews, and time for the scholar to adjust to what is happening during the process (Evans et al., 2009).

This study enabled me to understand the relationship that exists between the lack of awareness of the profession and the shortage of personnel in the CLS profession. In addition, conducting this study helped me to understand how to address that specific lack of knowledge and awareness. As a scholar, I learned about the ways in which teachers can be encouraged to develop students' awareness of the CLS profession. I have always envisioned myself beginning the journey of higher education and adult learning, but I cannot believe it is getting closer to the goal and I feel proud of my accomplishments. Through the implementation of the study, I have come to a greater understanding and appreciation of prior research and my ability to add to the knowledge base on this important topic.

Analysis of Self as Practitioner

I learned lessons as a practitioner that were very useful during the research process. Being a practitioner takes wisdom and work and organization to ensure research is presented in a scholarly manner and in accordance with the university's IRB regulations. During the IRB process, I began to see myself in the role as a practitioner in the research expedition. After choosing the topic, I had to decide on the data collection tools, the number of participants, and tools to analyze the data.

The systematic and detailed IRB application had to include all the information for data collection. The IRB application had to include the how, when, and where of data collection. It took me several attempts to get IRB approval. As a practitioner, I learned

that being proactive in making the necessary adjustments per IRB criteria is essential in avoiding unnecessary delays and barriers to the data collection process. I am proud to say the IRB application was finally approved so I could begin to collect data, continue with the study, and get results needed to develop a project.

Analysis of Self as Project Developer

My role as a beginning project developer was challenging, and I learned much about how to design, develop, deliver, and evaluate the project. The development of the workshop taught me to perform weekly planning tasks such as objectives, agenda items, and a timeline for the 3-day workshop. After reviewing models such as Tyler's model of curriculum development (Marsh, 2009) and Caffarela's (2010) interactive model, I chose Tyler's model to develop the project. I sought plans that would focus on learning objectives, learning activities, products, learning outcomes, evaluation, and assessment as integral components in planning the workshop. As a project planner and developer, I had to choose the model that would most effectively address the participants' needs. I have learned during the process how to develop a professional-development workshop for educators. I intended the 3-day professional workshop to promote awareness of the CLS profession, and become part of all science teachers' orientation in the school district.

The Project's Potential Impact on Social Change

The impact on social change that my project may have on high schools, colleges, and hospital organizations depends on the outcome of the professional-development workshop. If teachers take the knowledge of CLS gained through the professional-development workshop and communicate this knowledge to students, the students may be

encouraged to enter the field of CLS, thereby reducing the shortage of CLS staff and personnel. The expansion of student career awareness of CLS careers will hopefully result in more students opting for degree programs in this field. More graduates of CLS programs means more qualified professionals to serve the medical community (March, 2009).

Implications, Applications, and Directions for Future Research

Assisting high school science teachers to become more aware of the CLS profession could possibly assist with promoting and preparing students for the CLS academic collegiate programs and ultimately the profession. The review of the literature indicated no other research studies have addressed the same research questions. The use of a survey as a data collection tool in a future study will allow me to use greater number of professionals, teachers, parents, and students. Future exploration and research might examine how college and university enrollment rates in CLS degree programs have changed, and if high school science teachers are promoting CLS profession due to more information on the opportunities in the profession.

Based upon the findings of this study, future research should analyze whether colleges student enrollment increases for CLS programs. I propose a case study design that would continue the work of the research findings in this study. The case study would focus on a college CLS program's historical record or trends in enrollment of students over the past few years.

Conclusion

The purpose of this study was to explore high school students' understanding and perceptions of allied health professions, the factors that influence college students in CLS-related programs and CLS professionals to select CLS as a profession, and the anticipated consequences if the field does not adequately address the shortage.

This study used a qualitative research methodology. Individual interviews and focus groups were conducted with high school students, college students enrolled in CLS programs, and practicing CLS professionals.

This phenomenological study may help CLS teachers, hospital administrators, and other stakeholders address the pending shortage of CLS technicians. The study justified the need for a career-awareness workshop as a worthwhile endeavor to support high school science educators in learning more about CLS careers and degree programs. A career-awareness workshop for high school science teachers is a necessary approach to create any introduction of the CLS profession to high school students. A workshop that allows participants to reflect on past and current experiences, new knowledge and skills, will promote purposeful meaning for what is being learned; therefore, new knowledge will be developed for the participants.

This project aimed to integrate best practices in career awareness and principles to create an effective career-awareness workshop. In turn, a comprehensive career awareness workshop was designed and proposed to meet the needs of the community high school in the Chicagoland area to address shortages of CLS professionals. A career-awareness workshop for science teachers could lead teachers to encourage students to

enroll in CLS. The expansion of student career awareness of CLS careers will hopefully result in more students opting for degree programs in this field. More graduates of CLS programs means more qualified professionals to serve the medical community.

References

Abele, A., & Spurk, D. (2009). The longitudinal impact of self-efficacy and career goals on objective and subjective career success. *Journal of vocational behavior. 74*(1), 53-62. doi: 10.1016/j.vb.2008.10.005

Air, M., Manyselka, P., Vehvillinen, A., & Kumpuslo, E. (2010). Occupational isolation Among general practitioners in Finland. *Occupational Medicine. 60*(6),430-435. doi:10.1093/occmed/kqq082.kqq082.Epub2010Jun22

Akers, R. L. (2011). *Social learning and social structure: A general theory of crime and deviance*. Retrieved from http://books.google.com./books?id=zjBDZ-T0WMgC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Alexander, C. S., & Sysko, J. M. (2011, April). A study of the cognitive determinations of generation Y's entitlement mentality, *Academy of Educational Leadership, 2*, 1-5. Retrieved from: https://www.thefreelibrary.com/A+study+of+the+cognitive+determinants+of+generation+Y%27s+entitlement...-a0289620439

Allan, J., O'Neara, P., Pope, R., Higgs, J., & Kent, J. (2011). The role of context in establishing university clinics. *Health and Social Care in the Community, 19,* 217-224. doi:10.1111/j.1365-2524.2010.00971.

American Society for Clinical Pathology (ASCP) 2011. Technologist Certification, Medical Laboratory Scientists, MLS(ASCP). Retrieved from http:www.ascp.org/FunctionalNavigation/certification/GetCertified/TechnologistCertification.aspx#mt

American Society for Clinical Pathology (ASCP) Laboratory Professionals. (2012). *Careers in pathology and medical laboratory science.* Retrieved from www.ascp.org/Laboratory-Professionals

Argaw, T., & Wilson, C. (2012). Methods and tools for detecting and evaluation of the risks of porcine endogenous retrovirus in porcine to human Xenotransplatatin. *Journal of Virology, 86*, 9096-9104. doi: 10.5772/28779

Aronson, J. K. (2010). A manifesto for clinical pharmacology from principles to practice. *British Journal of Clinical Pharamcology, 70*(1), 3-13. doi.org/10.1109/ice.2015.7438666

Baker, C. (2013). A bright future: Exciting new technologies and growing need for skilled professionals place laboratory at the forefront of excellent patient care. *Advance, 25*(4), 8. doi:10.1016/0146-6402(78)90002-4

Ball, K., & Gotsill, G. (2010). *Surviving the baby boomer exodus: Capturing knowledge for gen X and Y employees*. Boston, MA: Course Technology.

Bamberger, M., Rugh, J., & Mabry, L. (2012). *RealWorld evaluation: Working under budget, time, data, and political constraints* (2nd ed.). Thousand Oaks, CA: Sage.

Bandura, A. 1986. Social foundations of thought and action: A social cognitive theory. Englewwod Cliffs, NJ: Prentice Hall.

Bandura, A. 2012. On the functional properties of perceived self-efficacy revisited. *Journal of Management. (38)*1, 9-44. doi:10.1177/0149206311410606

Bandura, A. (1991). Social cognitive theory of moral thought and action. In W. M. Kurtines & J. L. Hewitt (Eds). *Handbook of moral behavior and development.* (Vol. 1, pp. 45-103). Hillsdale, NJ: Erlbaum

Bandura, A. (1977). *Social learning theory*. New York, NY: General Learning Press.

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology, 3*, 265-298.doi: 10.1207/S1532785XMEP0303_03

Bandura, A. (2011). S*ocial foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (2012). On the functional properties of perceived self-efficacy revisited. *Journal of Management. (38)* 1, 9-44. doi: 10.1177/0149206311410606

Biggerstaff, D., & Thompson, A. (2008). Interpretative phenomenological analysis (IPA): A qualitative methodology of choice in healthcare research. *Qualitative Research in Psychology,* 5, 179-184. doi: 10.11080/14780880802314304

Bloom, B. S. (Ed.). (1956). *Taxonomy of education objectives, the classification of educational goals—Handbook I: Cognitive domain.* New York, NY: McKay.

Bloom, B. (2009). Taxonomy of Educational Objectives Book 1: Cognitive Domain. 2nd edition. Addison Wosley Publishing.

Bloomberg, L., & Volpe, M. (2012). *Completing your qualitative dissertation: A road map from beginning to end* (2nd ed.). Thousand Oaks, CA: Sage.

Brown, D. (2002). The Role of Work and Cultural Values in Occupational Choice, Satisfaction, and Success: A Theoretical Statement. *Journal of Counseling and Develoopment. 80*(1), 48-56. doi:10.1002/j.1556-6678.2002.tb00165.x

Bryman, A. (2012). *Social research methods* (4th ed.). New York, NY: Oxford University Press.

Bureau of Labor Statistics, U.S. Department of Labor. (2010). Clinical laboratory technologists and technicians. *Occupational outlook handbook* (2010-2011) edition. Retrieved from http:www.bls.gov/oco/ocos096.htm

Butina, M. L. (2010). *Understanding the personal and professional identity of clinical laboratory practitioners through narrative* (Doctoral dissertation). University of Atlanta, Georgia.

Butler, C. (2011). *Hegel's logic: Between dialectic and history.* Evanston, IL: Northwestern University Press.

Caffarella, R. S. (2010). Designing instructional plans. In R. S. Caffarella. 2nd edition. *Designing and assessing learning experiences* (pp. 175-212). Hoboken, NJ: Wiley.

Campbell, S., & LaCost, B. (2009). CLS to higher education administration: The right place-right time. *Clinical Laboratory Science, 22*(3), 185-192. Retrieved from: http://www.freepatentsonline.com/article/Clinical-Laboratory-Science/277345331.html

Carden, R., Allsbrook, K., & Thomas, R. (2009). An examination of the supply and demand for clinical laboratory professionals in the United States. *Journal of Blood Services Management, 49*(11), 2520-2523. doi:10.1111/j.1537-2995.2009.02469.x

Carden, A. & Zappala, J. (2009). *Public Relations Writing Worktext: A Practical Guide for the Profession.* 3rd edition. Routledge, New York and London

Carpenter, D. R. (2010). Phenomenology as a method. In H. J. Streubert Speiale & D. R. Carpernter (Eds.), *Qualitative research in nursing: Advancing the humanistic imperative* (5th ed., pp. 75-101). Philadelphia, PA: Lippincott Williams, & Wilkins.

Casina, T. S. (2011). Technologies to improve the future of blood banking. *MLO: Medical Laboratory Observer, 32,* 1. Retrieved from: http://www.mlo-online.com/technologies-to-improve-the-future-of blood-banking.php

Chen, Z. C. Y., Fung, Y. L., & Chien, W. T. (2013). Bracketing in phenomenology: Only undertaken in the data collection and analysis process? *The Qualitative Report, 18*(59)*,* 1-9. Retrieved from: http//www.researchgate.net/publication/288270826_bracketing_in_phenomenology_only_undertaken_in_data_collection_and_analysis_process

Christenbury, L. (2011). The flexible teacher. *Effective Education.* 2011;68(4):46-50. Retrieved from: http://www.ascd.org/publications/educational-leadership/dec10/vol68/num04/The-Flexible-Teacher.aspx

Chung, H. M., & Behan, K. J. (2011). Peer sharing facilities the effect of inquire-based projects on science learning. *The American Biology Teacher, 72*(1), 24-29. Retrieved from: http://www.eric.ed.gov/?id=EJ884155

Clark, D. (1995). Blooms taxonomy of learning domains. The here types of learning. Retrieved from http://www.nwlink.com/Donclark/hard/bloom.html#affective

Clark, D. (2005). *Building expertise. Cognitive methods for training and performance improvement.* Washington. DC: Book of International Society for Performance Improvement.

Cleophas, T. J., & Zwinderman, A. H. (2010). Item response modeling for clinical and laboratory testing. *European Journal of Clinical Investigation, 40,* 911-917. doi:10.1111/j.1365-2362.2010.02362.x

Coenders, F., Terlouw, C., Dijkstra, S., & Pieters, J. (2010). The Effects of the Design and Development of a Chemistry Curriculum Reform on Teachers' Professional Growth: A Case Study. *Journal of Science Teacher Education 21*(5): 535-557. doi:10.1007/s10972-010-9194-z

Cooke, M., Watson, B., Blacklock, E., Manash, M., Howard, M., Johnston, A.N.B., Tower, M., & Murfield, J. (2012). Lecture capture: first year student nurses' experiences of a web-based lecture technology. *Australian Journal of Advanced Nursing, 29*(3), 14-21. Retrieved from: http://www.98.griffith.edu.au/dspace/bitstream/handle/10072/47133/78813

Corbin, J. M., & Strauss, A. L. (2015). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (4th ed.). Los Angeles, CA: Sage.

Corbin, J.M. & Strauss, J. M. (2014). *Basic of qualitative research: Techniques and procedures for developing grounded theory* (3rd ed.). Thousand Oaks, CA: Sage.

Creswell, J.W. (2009). *Qualitative inquiry and research design: Choosing among five traditions* (2nd Ed.) Thousand Oaks, CA: Sage.

Creswell, J. (2012). *Qualitative inquiry & research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Crowley, C. (2012). High demand, low supply. *TimesUnion, 9,* 1-7. Retrieved from: http?www.timesunion.com/business/article/High-demand-low-supply-3839665.php

Cullen, R., & Harris, M. (2012). *The learner-centered curriculum: Design and implementation*. San Francisco, CA: Jossey Bass.

Curriculum [Def. 1]. (n.d.). Merriam-Webster Online. In Merriam-Webster. Retrieved January 2, 2013, from http://www.merriam-webster.com/dictionary/citation.

Dass, P., & Yager, R. (2009). Professional development of science teachers: History of reform and contributions of the STS-based Iowa Chautauqua program. *Science Education Review, 8*(3), 99-111. Retrieved from: http://www.scienceeducationreview.com/open_access/dass-pd.pdf

Denzin, N. K., & Lincoln, Y. S. (2011). The discipline and practice of qualitative research in N. K. Denzin, & Y. S. Lincoln (Eds). *The SAGE handbook of qualitative research* (3rd ed., pp. 1-32). Thousand Oaks, CA: Sage.

Doran, M. (2009). Perceptions and attitudes of college science students regarding careers in clinical laboratory science. *Theses.* Paper 119.

Dowling, M., & Cooney, A. (2012). Research approaches related to phenomenology: Negotiating a complex landscape. *Nurse Researcher, 20*(2), 1. doi:10.7748/nr2012.11.20.2.21.c9440

Enrado,P. (2009). Closure of clinical sciences programs threatens healthcare industry. *Healthcare Finance.* May 2009. Retrieved from: http://www.healthcarefinancenews.com/news/closure-clinical-lab-sciences-programs-threatens-healthcare-industry

Evans, N., Forney, D., Guido, F., Patton, L., & Renn, K. (2009). *Student development in college: Theory research and practice*. (2nd ed.) San Francisco, CA: Jossey-Bass.

Flores, M. (2010). *An investigation of high school dual enrollment participation and allied health program enrollment in a south Texas university.* Retrieved from ProQuest Dissertations and Thesis. (UMI Number 3440030)

Fried, B. J., & Fottler M. D. (2011). *Human resources in healthcare: Managing for success* (3rd ed.). Chicago, IL: Health Administration Press.

Garcia, E., Ali, A., & Choundry, S. (2013). The American society for clinical pathology's 2012 wage survey of clinical laboratories in the United States. *Laboratory Medicine*, *44(1),* 1-18. Doi: 10.1309/LMWO4F34BOGHZXGM

Garcia, E., & Fisher, P. (2013). The American society for clinical pathology's 2013 wage survey of clinical laboratories in the United States. *Laboratory Medicine*, *44(4,)* 8. doi.org/10.1309/LMWO4F34BOGHZXGM

Ghazarossian, S. (2010). *Laboratory managers' attitudes toward clinical laboratory scientists shortage* (Doctoral dissertation). A.T. Still University, Kirksville, MO.

Glesne, C. (2011). *Becoming qualitative researchers: An introduction.* Boston, MA.: Allyn & Bacon.

Grundy, W., & Miesch, A. (2013). Brief descriptions of statpac and related statistical programs for the IBM personal computer. Documentation: Report 87-411. *National Center for Biotechnology Information, 282*(25), 30. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17428787

Guest, G., MacQueen, K., & Namey, E. (2012). *Applied thematic analysis.* Thousand Oaks, CA: Sage.

Hale, J., & Dunlap, R. (2012). *An educational leader's guide to curriculum mapping: Creating and Sustaining.* Thousand Oaks, CA: Sage.

Hale, J. & Dunlap, R. (2012). *An Educational Leader's Guide to Curriculum Mapping: Creating and Sustaining Collaborative Cultures.* Routledge, New York and London.

Hancock, D., & Algozzine, B. (2011). *Doing case study research: A practical guide for beginning researchers.* New York, NY: Teachers College Press.

Hanauer, D., & Bauerle, C. (2012). Facilitating Innovation in Science Education through Assessment Reform. *Liberal Education. 98*(3), 14-15. Retrieved from: https://www.aacu.org/publications-research/periodicals/facilitating-innovation-science-education-through-assessment

Hans, T. (2000). A meta-analysis of the effects of adventure programming on locus of control. *Journal of Contemporary Psychotherapy, 30*(1), 33-60. doi: 10.1023/A:1003649031834

Hodkinson, P., Sparkes, A., & Hodkinson, H. (1996) *Triumphs and tears: Young people, markets and the transition from school to work*. London, England: David Fulton.

Hogan, J., & Matheson, S. (2010, September/October). Local high school and college outreach. *The LAByrinth ISDH Laboratory Newsletter,* Retrieved from http://www.in.gov/isdh/files/LAByrinth-Sept-Oct09.pdf

Huitt, W. (2011). Bloom et al.'s taxonomy of the cognitive domain. *Educational*

Psychology Interactive. Valdosta, GA: Valdosta State University. Retrieved from http://www.edpsycinteractive.org/topics/cognition/bloom.html

Hutchings, P. (2011). *The scholarship of teaching and learning reconsidered: Institutional integration and impact*. San Francisco, CA: Jossey-Bass.

Jamieson, L., & Lohmann, J. (2009) Creating a culture for scholarly and systematic innovation in engineering education: Phase 1 report. *American Society for Engineering Education*. Retrieved from http://www.asee.org/papers-and-publications/publications

Jonassen, D., & Land, S. (Eds.). (2012). *Theoretical foundations of learning environments.* Retrieved from http://derrel.net/readings/TheoreticalFoundations.htm

Kaner, C., & Fiedler, R. (2013). *Qualitative Methods for Test Design. Software Test Professionals Conference*. San Diego, CA.

Kaplan, R., & Burgess, T. (2011). The impending crisis in the clinical laboratory workforce. *Journal of Microbiology and Biology Education, 11,* 140-143. doi:10.11128/jmbe.v11i230

Kibak, P. (2008). *Raising awareness of clinical laboratory science.* Retrieved from: http://www.aacc.org/publications/cln/archive/2008/July/dailies/Pages/tues_daily2.aspx#

Killon, J., & Roy, P. (2009). *Becoming a learning school.* Oxford, OH: National Staff Development Council.

Kimball, A., & Resneck, J. (2008). The U.S. dermatology workforce: a specialty remains in shortage. *Journal America Academy of Dermatology, 59*, 741-745. doi: 10.1016/jjaad.2008.06.037

Krumboltz, J. D. (1994). Improving career development theory from a social learning perspective. In M. L. Savickas & R. L. Lent (Eds.). *Convergence in career development theories* (pp. 9-31). Palo Alto, CA: CPP Books.

Krumboltz, J. (2009). The Happenstance Learning Theory. *Journal of Career Assessment. (17)*2, 135-154. doi: 10.1177/1069072708328861

Krumboltz J. & Nichols, C. (1986). *Integrating the Social Learning Theory of Career Decision Making*. San Francisco. CA: Jossey-Bass..

Kwok J., & Jones, B. (2005). Unnecessary repeat requesting of tests: An audit in a government hospital immunology laboratory. *Journal of Clinical Pathology, 58*, 457-462. Doi: 10.1136/jcp.2004.021691

Lankshear, C., & Knobel, M. (2011). New literacies: Everyday practices and social learning. New York, NY: McGraw-Hill International.

Laposata, M. (2004). Patient-specific narrative interpretations of complex clinical laboratory evaluations: Who is competent to provide them? *Clinical Chemistry, 50*, 471-472. Doi.10.1373/clinchem.2003.028951

Lee, C. (2013). *Multicultural issues in counseling: New approaches to diversity.* Alexandria, VA: American Counseling Association.

Lent, R. W., Brown, S. D., & Hackett, G. (2002). Social cognitive career theory. In D. Brown & Associates (Eds.), *Career choice and development* (4th ed.; pg. 1-559). San Francisco, CA: Jossey-Bass.

Lodico, M., Spaulding, D., & Voegtle, K. (2010). *Methods in educational research: From theory to practice.* San Francisco, CA: Jossey-Bass.

Loucks-Horsley, S., Stiles, K., Mundry, S, Love, N. & Hewson, P. (2010). *Designing professional development for teachers of science and math.* Los Angeles, CA: Sage.

Louis, D. N., Virgin, H. W., & Asa, S. L. (2011). "Next generation" pathology and laboratory medicine. *Archives of Pathology and Laboratory Medicine, 135,* 1531-1534. Doi.org/10.5858/arpa.2011-0414-ED

Maddox, N. (2011). Arizona State Public Health Laboratory. Strategic Thinking in The Canyon State. *Lab Matters.* Fall 2011, Issue 4.

Malone, B. (2011, May). Trends in recruitment and retention. How can labs thrive despite the staffing shortage? *Clinical Laboratory News, 3(37).* Retrieved from http://www.aacc.org/publications/cln/2011/May/Pages/TrendsinRecruitment.asp

Marks, N. J. (2011). Stem cell researchers' trust, ambivalence and reflexivity: opportunities for improved science-public relations? *Science and Public Policy, 38,* 541-554. doi: 10.3152/030234211X12960315267651

Marques, M. B., Anastasi, J., Ashwood, E., Baron, B., Fitzgerald, R., Fung, M., …, Rinder, H. M. (2011). The clinical pathologist as consultant. *The American Society for Clinical Pathology*, *135*,11-12. doi:.org/10.1309/AJP0EZMP6HJORBK

Marsh, C. (2009). *Key concepts for understanding curriculum.* London, New York: Routledge

Marshall, C., & Rossman, G. B. (2011). *Designing qualitative research*. Thousand Oaks, CA: Sage.

Martin, C. (2009). *Allied health: The hidden health care workforce*. Retrieved from http://www.oshpd.ca.gov/RHPC/Jobs/HiddenHealthCareWorkforceReport_09_V7.pdf, 1-8

Massiha, G. (2011). Discovery camp excites students about engineering and technology careers. *Technology Education and Engineering,* 71(4), 20-21. Retrieved from: http://eric.ed.gov/?id=EJ956772

Mastascusa, E., Snyder, W., & Hoyt, B. (2011). *Effective instruction for STEM disciplines: from learning theory to college teaching*. San Francisco, CA: Jossey-Bass.

McClure, K. (2009). Student perceptions of the clinical laboratory science profession. *Clinical Laboratory Science, 22*(1), 24-31. Retrieved from: http://www.ncbi.nim.nih.gov/pubmed/1935023

McNeill, K. L., & Pimentel, D. S. (2010). Scientific discourse in three urban classrooms: The role of the teacher in engaging high school students in argumentation. *Science Education*, *(94*), 203-229.

Medical Laboratory Observer. (2011), Salary survey offers new view of the lab industry. *Medical Laboratoryx Observer, 43,* 30-32. Retrieved from: http://www.mlo-online.com/salary-survey-offers-view-of-lab-industry.phb

Merriam, S. B. (2010). *Qualitative research: Design and application guide.* San Francisco, CA: Jossey-Bass.

Micari, M., & Pazos, P. (2012). Connecting to the professor: Impact of the student-faculty relationship in a highly challenging course. *College Teaching, 60*(2), 41-47. doi: 10.1080/87567555.2011.627576

Munson, A., Moskal, B., Harriger, A., Lauriski-Karriker, T., & Heersink, D. (2011). Computing at the high school level: Changing what teachers and students know and believe. *Computers & Education,* 57(2), 1836-1849.

Myers, A., & Berkowicz, J. (2015). *The STEM shift: A Guide for School Leaders.* Thousand Oaks, CA: Corwin.

Nace, L. (2012). Endangered or empowered? *Advance for Medical Laboratory Professionals, 24*(2), 5.

National Accrediting Agency for Clinical Laboratory Science. (2011). *Central Texas Phlebotomy Institute*. Retrieved from http://phlebotomytraininglocator.com/central-texas-phlebotomy-institute/

Neilson, E. G., Johnson, K. B., Rosenbloom, S. T., Dupont, W. D., Talbert, D., Giuse, D. A. Miller, R. A. (2004). The impact of peer management on test ordering behavior. *Annals of Internal Medicine*, *141*, 196-204. Retrieved from: http://ww.ncbi.nim.nih.gov/pubmed/15289216

Niles, S. G., & Harris-Bowlsbey, J. (2005). *Career development interventions in the 21st century* (4th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Oja, K. J. (2011). Using problem-based learning in the clinical setting to improve nursing students' critical thinking: an evidence review. *Journal of Nursing Education, 50*(3), 145-151. doi: 10.3928/01484834-20101230-10

Palumbo, M., Rambur, B., Mcintosh, B., & Naud, S. (2008). Perceptions of an ideal career versus perceptions of six health careers. *Journal of Allied Health, 37*(1), 8-16. Retrieved from: http://www.ncbi.nim.nih.gov/pubmed18444434

Passiment, E. (2006), Regulatory agencies involved with the clinical laboratory. *The American Society for Clinical Laboratory Science, 19*(1), 43-9. Retrieved from: http://www.researchgate.net/publication/716797_regulatory_agencies_involved_with_the_clinical_laboratory

Plebani, M., & Lippi, G. (2010). Darwinian evolution or regression? The fate of laboratory professionals. *Clinical Chemistry Laboratory Medicine, 48,* 1367-1368. Retrieved from: https://www.degruyter.com/abstract/j/cclm.2010.48.issue-10/cclm.2010.298/cclm.2010.298.xml

Price, C. P. (2010). Roots, development and future directions of laboratory medicine. *Clinical Chemistry Laboratory Medicine, 48,* 903-909. doi: 10.1515/CCLM

Richmond, S. (2009). The value of continuing education. *Medical Laboratory Observer, 41,* 4.

Royse, D., Thyer, B., & Padgett, D. (2014). *Program Evaluation: An introduction to an evidence based approach.* Boston, MA: Cengage Learning.

Rubin, H., & Rubin, I. (2012). *Qualitative interviewing: The art of hearing data.* DeKalb, IL: Sage.

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education, 96*(3), 411-427. Retrieved from:

https://relwest.wested.org/system/documents/pdfs/391/orignal/REL_West_website.Gender_differences_in_interest_in_STEM_201409.pdf?1415139887

Saldana, J. (2012). *The coding manual for qualitative researchers.* Thousand Oaks, CA: Sage.

Salkind, G. M. (2010). *Coaches' and principals' conceptualizations of the roles of elementary mathematics coaches* (Unpublished doctoral dissertation). George Mason University, Fairfax, VA.

Sarzotti-Kelsoe, M., Cox, J., Cleland, N., Denny, T., Hural, J., Needham, L., Simkins, A. (2009). Evaluation and recommendations on good clinical laboratory practice. *Plos Med 6(5).* Published online May 5, 2009. doi:10.1371/journal.pmed.1000067

Sasnett, B., Royal, P., & Ross T. (2010). Introduction of a cultural training experience into interdisciplinary health science education program. *Journal of Allied Health, 39*(2), e55-60. Retrieved from: http://www.ecu.edu.cs-dhs/hsim/sasnet.cfm

Schilling, D., Schwallie-Giddis, P., & Giddis, J. (2011). *Preparing teens for the contemporary workforce.* Torrance, CA: Innerchoice

Scott-Clayton, J. (2011). On money and motivation. *Journal of Human Resources, 46*, 614-646. doi: 10.3368/jhr46.3.614

Sheu, J. J., Kang, J. H., Lin, H. C., & Lin, H. C. (2010). Hyperthyroidism and risk of ischemic stroke in young adults: A 5-year follow-up study. *Stroke*, *41*, 961-966. doi: 10.1161/STROKEAHA.109.577742

Shieh, R. S. (2012). The impact of technology-enabled active learning (TEAL) implementation on student learning and teachers' teaching in a high school

context. *Computers & Education, 59*(2), 206-214. Retrieved from http://www.ascilite.org.au/ajet/ajet27/shieh.pdf

Small, K. S. (2013). Retention Strategies for Medical Technologists: Addressing the Shortages and Vacancies in the Clinical Laboratory. Retrieved from https://adfs.ccc.edu/adfs/ls/

Smith, J. A., & Osborn, M. (2015). *Interpretative phenomenological analysis as a useful methodology for research on the lived experience of pain. British Journal of Pain 9*, 41-42. doi: 10.1177/2049463714541642

Smith, J.A., Flowers, P., & Larkinm M. (2009). *Interpretative Phenomenological Anaylsis: Theory, Method and Research.* London: Sage.

Synder, A.J. (2009). Gender, self-efficacy, gender and vocational interests among high school students using the Strong Interests Inventory and Skills Confidence Inventory. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 70*(6)-A. doi: 99230309AAI336I365

Spaulding, D. & Voegtle, K. (2010). *Methods in Educational Research: From Theory to Practice.* 2nd edition. San Francisco, CA: Jossey-Bass.

Stanford, J. E. (2012). *Behind the test result: Promoting the profession within the walls of the hospital*, 1-3. Retrieved from http://laboratory-manager.advanceweb.com/Web-Extras/Online-Extras/Behind-the-Test-Result.aspx

Straub, E. (2009). Understanding Technology Adoption: Theory and Future Directions for Informal Learning. *Review of Educational Research. 79*(2), 625-649. doi: 10.3102/003465430825896

Szabo, J. (2011*).* Rural hospitals look near and far for allied health professionals. *Hospitals and Health Networks, 85(5),* 30-35. Retrieved from: http://www.hhnmag.com/articles/4504-rural-hospitals-look-near-and-far-for-allied-health-professionals

Thornton, K. (2011). Reversing the lab-workforce shortage trend. *Advance for Administrators of the Laboratory, 25*(3), 1-4. Retrieved from: http//laboratory-manager.advanceweb.com/Feaatures/Articles/Reversing-the-Lab-Workforce-Shortage-Trend.aspx

Tudge, J. R., & Winterhoff, P. A. (2010). Vygotsky, Piaget, and Bandura: Perspectives on the relations between the social world and cognitive development. *Human Development, 36*(2), 61-81. Retrieved from: http://www.uncg.edu/hdf/faultystaff/Tudge/vpb93.pdf

Tyler, R. W. (1949) *Basic principles of curriculum and instruction*. Chicago: University of Chicago Press.

Tyler, R. W. (1986). The five most significant curriculum events in the twentieth century. *Educational Leadership, 44,* 36-38. Retrieved from: http://eric.ed.gov/?id=EJ347088

Vella, J. (2010). The seven design steps. In Rosemary S. Caffarella (Ed.), *Designing and assessing learning experiences* (pp. 65-83). San Francisco, CA: Jossey-Bass.

Veness, D. (2010). *Educational reflection: Models and theories of curriculum design.* Retrieved from http://educational-reflections.blogspot.com/2010/11/when-teachers-are-asked-to-develop.html

Vik, P. (2013). *Regression, ANOVA, and the general linear model: A statistics primer.* New York, NY: Prentice Hall.

Waight, N. & Khalick, A. (2011). From scientific practice to high school science classrooms: Transfer of scientific technologies and realizations of authentic inquiry. *Journal of Research in Science Teaching. (48)*1, 37-70. doi:10.1002/tea.20393

Wang, M. Olson, D.A. & Schultz, K. (2013). *Mid and Late Career Issues.* New York and London: Routledge.

Wellard, S. J., & Heggen, K. M. (2010). Are laboratories useful fiction? A comparison of Norwegian and Australian undergraduate nursing skills laboratories. *Nursing and Health Sciences, 12,* 39-44. doi: 10.111/j.1442-2018.2009.00491.x

Zaleski, M. S. (2011). Automation, the workforce and the future of the laboratory. *MLO: Medical Laboratory Observer, 43*(7), 59.

Zaleski, M.S. (2013). The influence of momentary classroom goal structures on student engagement and achievement in high school science. ProQuest Dissertations and Theses; (PhD). Northern Illinois University, 2013: Publication Number: AAT 3552420: ISBN: 9781267909114: Source: Dissertation Abstracts International, Volume 74-06(E), Section: A.; p.137.Retrieved from: http://www.mlo-online.com/automation-the-workforce-and-the-future-of-the-laboratory.phb

Zhi, M., Ding, E. L., Theisen-Toupal, J., Whelan, J., & Aramout, R. (2013). The landscape of inappropriate laboratory testing: A 15-year meta-analysis. *Public Library of Science One, 8(11).* Doi.org/10.1371/journal.pone.0078962

Appendix A: Project

Title of Professional Development: High School Professional Development on the Awareness of CLS Profession

Purpose: The purpose of the project is to promote the CLS profession to high school students, using science teachers' facilitators who initiate career-awareness integration into their existing curriculum. The 3-day professional-development workshop will provide science teachers an opportunity to update curriculum to provide for the infusion of CLS principles and clinical skills that promote awareness of and enthusiasm for the CLS field.

Goals: The goal of the 3-day professional-development workshop is to increase science educators' awareness of the CLS profession. The study results were provided to the teachers during the workshop opening day presentation. A faculty development approach that capitalizes on existing skills held by science educators will provide science teachers with the skills and confidence necessary to achieve this goal.

Objectives: The program outcomes for the 3-day career professional-development workshop are for teachers to be able to

1. Understand, interpret, compare, and contrast the different careers in healthcare.
2. Define career-awareness and career-development programs.
3. Apply knowledge to implementing a career-awareness program in the high school science curriculum.
4. Identify the organizational structure of allied health programs.
5. Identify different health care programs and how they affect societal needs.

6. Utilize the CLS professional-development workshop to create a career-awareness.

    Desired Outcomes: The desired outcomes are the integration of social learning theory and knowledge of career decisions into curriculum design. The proposed faculty development approach that capitalizes on existing skills held by science educators will provide science teachers with the skills and confidence necessary to achieve this goal.

Target Audience: The target audience is high school science teachers currently teaching a science course in the community high school.

Timeline: Table 7 shows the proposed timeline for the study.

Table A1

Timeline

Topic and Time	Task	Participants
2 weeks prior to workshop	Needs assessment	Program facilitator & science teachers
1 week prior to workshop	Incorporate tenets of Tyler's model for curriculum development	Science teachers
Formative Evaluation	Facilitator evaluation of teaching	Science teachers
Workshop: part 1 8 hours	Career-awareness theories	Science teachers
Consultation services Ongoing, by appointment as needed		Program facilitator & science teachers
Workshop: part 2 8 hours	Career exploration concepts and self-exploration processes	Program facilitator & science teachers
Consultation services Ongoing, by appointment as needed		Program facilitator & science teachers
Workshop: part 3 8 hours	Career planning skills & exposure to learners of careers in CLS	Program facilitator & science teachers
Evaluation, summative	Summative evaluation of program	Science teachers
Consultation services Ongoing, by appointment as needed		Program facilitator & science teachers
Transfer of learning	Facilitator evaluation of teaching	Program facilitator & science teachers
Summative Evaluation 6 and 9 months post evaluation	Facilitator evaluation of teaching	

Specific Activities of Workshop: The specific activities of the workshop include the needs assessment, teaching materials, and evaluation methodologies.

1. Needs Assessment: First, the facilitator will gather support from the high school principal and other stakeholders to facilitate the program. Next, the needs assessment will be distributed two weeks prior to the workshop to teachers to identify individual needs. The teachers will return the needs assessment 1 week prior to the workshop. The facilitator will review all needs assessments to adjust course curriculum to meet the needs of the teachers better.

Needs Assessment

Table A2

Needs Assessment

Learning Needs Assessment Form

Learning Needs Assessment Form					
Teacher Name:					
Course Title: High School Professional Development on the Awareness of CLS Profession					
Trainer: Cynthia Funnye Doby, MAEd, B.S., MLS	High School Name:				
Course Description:	Three-day workshop whose purpose is to inform high school science teachers of the CLS profession, core tenets of social learning and career decision theories, Tyler's model for curriculum design, and evaluation methodologies.				
1. Please rate your current knowledge level of the clinical laboratory science profession (CLS). 2. Please rate your current knowledge level of designing curriculum using Tyler's model. 3. Please rate your current knowledge level of Bloom's taxonomy of learning. 4. Please state what you would like to learn in this class about allied health professions, CLS. 5. Please add desired topics of interest for career-awareness for future professional development.	Expert	Proficient	Competent	Advanced	Novice

Note: Course objectives may change based upon the identified needs of the learner.

Work Shop Lesson Plan

Table A3

Activities

Day 1: Day 1 will focus be on career-awareness-theories and cultural context for career-awareness activities from the pre-assessment activity given to the learner 2 weeks prior to the workshop.		
Topic: Career awareness theories and cultural context		
Purpose: The purpose of the project is to promote the CLS profession to high school students, using science teachers as the facilitators who initiate career-awareness integration into their existing curriculum.		
Learning objectives	1. Will be able to define career assessment. 2. After completing the career-awareness exploration assessment (done prior to day 1 of workshop), 3. Will be able to utilize the resources available on different careers to be included in the science curriculum. 4. Will be able to utilize the career assessment report into the students learning experiences on career choices. 5. Will be able to understand what career-planning process is and that it can facilitate the attainment of educational and career goals. 6. Will be able to recall the career-planning model. 7. Will be able to describe the purpose of career assessment and related issues. 8. Will be able to identify both informal and formal career assessments. 9. Will be able to recall the career development four-step process. 10. Will collaboratively learn about how people get jobs using a tool. 10. Teachers will be able to effectively communicate and enhance the student's awareness of the CLS profession into the science curriculum.	
Outcome of course content(s)	To provide the learner with career exploration exercises to utilize in classroom curriculum to assess leaner career education knowledge and awareness of career opportunities. Career exploration exercises will be included in the high school science teacher's course to make aware of CLS profession.	
Time required break lunch	8:00 am-4:00 pm 9:45 am (15 minutes) 12:00 pm (45 minutes)	
Materials and resources	Career Assessment Tool (below) Career Exploration On Internet Tool (below) Career Worksheet (below)	
Instructional activities	Introduction: Learner will complete materials and resources on career exploration.	5 hours
Instructional activities and evaluations	At end of 1st day workshop, teachers will discuss collaboratively in a group session the findings of career exploration. The learners will complete a formative and summative evaluation regarding career exploration and career-awareness theories.	
Additional planning notes	Trainer will complete the career-awareness theory with learner at beginning of the 1st day of professional-development workshop to give learner an understanding of career choice and theory in practical a. Bandura's social learning theory b. Krumboltz's career-decision theory	

Note: Course objectives may change based upon the identified needs of the learner.

Day 1 Participant Formative Evaluation Form

Please briefly describe your experience in day one of this professional-development workshop.

1. To what extent did the first day of the professional-development workshop help you to understand career-awareness theories and cultural context for career-awareness strategy?

   If so, please explain.

   Please list two theorists provided to learner during day one of workshop.
   a.
   b.

2. To what extent did day one of the professional-development workshop help you with career-awareness activities from the pre-assessment activity given two weeks prior to the workshop?

   If so, please explain.

3. To what extent did the workshop effectively communicate to the science teacher adequate information to enhance the student's awareness of the CLS profession into the science curriculum?

   If so, explain.

   If not, please explain and what needs to change.

4. To what extent did the career-planning model assist the learner?

   If so, explain.

5. To what extent did the end of day collaborative exercise assist you with enhancing your findings of career explorations in allied health?

   If so, explain.

   If not, please explain and what needs to change.

Table A4

Activities

Day 2: Day 2 will focus on different career exploration concepts and self-exploration processes for science teachers to utilize in their science curriculum for high school students using the career development workshop.		
Topic: Career awareness and career development for science teachers.		
Purpose: The purpose of the project is to promote the CLS profession to high school students, using science teachers as the facilitators who initiate career-awareness integration into their existing curriculum		
Learning Objectives	1. Discuss the different career-awareness educational tools and optional resources available for career development and awareness. 2. Use a career and education planning worksheet to understand their self and occupational exploration. 3. Incorporate their goals for successful completion of a worksheet for student goal scenarios. 4. Identify and explore student's awareness of self and one's own culture, racism, sexism, economic status, labor market analysis, and individual differences as they relate to career exploration. 5. Help students to understand the importance of setting goals to reach their dreams. 6. Recall career options from the internet exercise on career exploration. 7. Prepare a lesson plan to on career-awareness context for the science curriculum.	
Outcome of course content(s)	To provide learner with career exploration exercises to utilize in classroom to assess leaner career education knowledge and awareness of career opportunities.	
Time Required Break Lunch	8:00 am-4:00 pm 9:45 am (15 minutes) 12:00 pm (45 minutes)	
Materials and Resources	Career Planning Model (below) Career Planning Worksheet (below) Lesson Plan for Teachers (below) Job Value Inventory (below)	
Instructional Activities and Evaluations	Assist learner with helping students with setting goals to reach career dream. Collaborate with learners from the internet exercise on career exploration. Collaborate with learners on different career-awareness educational schools and options to incorporate in their science curriculum. The learners will complete a formative and summative evaluation regarding setting goals in reaching career dream.	7 hours
Additional Planning Notes	Incorporate awareness of self and one's one culture in day 2 workshop agenda.	

Note: Course objectives may change based upon the identified needs of the learner.

Day 2 Participant Formative Evaluation Form

Please briefly describe your experience in day two of this professional-development workshop.

1. To what extent did the first day of the professional-development workshop help you to promote the CLS profession to high school students?

   If so, please explain.

   Please list how you will initiate career awareness into your science curriculum.
   c.
   d.

2. To what extent did the career and education planning worksheet help you to understand occupational explorations?

   If so, please explain.

3. To what extent did the workshop effectively assist with the importance of setting goals to reach for career exploration in the science classroom?

   If so, explain.

   If not, please explain and what needs to change.

4. To what extent did the workshop assist with planning a lesson plan to career-awareness context for science curriculum?

   If so, explain.

5. To what extent did the end of day collaborative exercise assist you with different career-awareness educational schools and options to incorporate into science curriculum?

   If so, explain.

   If not, please explain and what needs to change.

Table A5

Activities

Day 3: Day 3 will focus on information pertaining to career planning skills and systemic exposure to learners of careers in CLS and incorporating the profession into the science teacher's curriculum for high school students.		
Topic: Career-planning skills to expose learners of careers in CLS.		
Purpose: The purpose of the project is to promote the CLS profession to high school students, using science teachers as the facilitators who initiate career-awareness integration into their existing curriculum		
Learning Objectives	1. Will be able to define goal and its importance of success. 2. Will define CLS. 3. Will distinguish between what jobs are available as a CLS. 4. Will be able to assess a career planning form for students interested in CLS in college. 5. Will use the internet for navigating college websites that have the CLS program. 6. Will be able to communicate to other stakeholders and counselors the importance of the CLS profession for the twenty-first century. 7. Will be able to collaborate with counselors on information pertaining to the CLS profession.	
Outcome of course content(s)	To communicate with learner knowledge of the CLS profession and awareness of the CLS profession.	
Time Required Break Lunch	8:00 am-4:00 pm 9:45 am (15 minutes) 12:00 pm (45 minutes)	
Materials and Resources	Information on CLS profession (below) CLS educational requirements (below) Smart Goal Worksheet (below)	
Instructional Activities	Introduction to students of CLS Profession	7 hours
Evaluation	The learners will complete a formative and summative evaluation regarding social career decision theory, social learning theory, evaluation on awareness of CLS profession	
Additional Planning Notes	Trainer to Teacher Evaluation- Trainer will explain to teachers that after program implemented at their high school	

Note: Course objectives may change based upon the identified needs of the learner.

Day 3 Participant Formative Evaluation Form

Please briefly describe your experience in day 1 of this professional-development workshop.

1. To what extent did the first day of the professional-development workshop help you to understand career-awareness theories and cultural context for career-awareness strategy?

If so, please explain.

Please list two theorists provided to learner during day one of workshop.

a.
b.

2. To what extent did the third day of the workshop assist you to distinguish jobs available as a CLS?

If so, please explain.

3. To what extent did the third day of the workshop provide you with the ability to communicate to other stakeholders and counselors the importance of the CLS profession for the 21st century?

If so, please explain.

If not, please explain and what needs to change.

4. To what extent did day third day of the 3-day professional-development workshop help you using the internet for navigating college websites that have the CLS program?

If so, please explain.

5. To what extent did the end of day collaborative exercise assist you with collaboration with counselors on information pertaining to the CLS profession?

   If so, explain.

   If not, please explain and what needs to change.

Participant Summative Evaluation Form

Please briefly describe your overall experience in this 3-day professional-development workshop.

1. To what extent did this professional-development workshop help you incorporating the awareness of CLS profession into the high school students' science curriculum?

   If so, please list how the workshop will help.

2. To what extent did this professional-development workshop help you with collaborating with stakeholders on the importance of awareness of CLS profession to high school science students?

If so, please list some of the advantages.

3. To what extent did this workshop help you assemble ideas for using internet navigation tools as career exploration exercises in your science class?

   If so, please list how the workshop will assist.

4. Please identify the most useful part of this 3-day professional-development workshop.

5. Please input on which day of the workshop was more informational for you as the learner with providing awareness of the CLS profession.

6. Please identify one area of this professional-development workshop that needs improvement.

7. Would you recommend this professional-development workshop to other high school science teachers?

8. What were the strengths of the workshop? What are your takeaways from the workshop?

3-day Professional Workshop for Science Teachers Materials and Resources

Day 1 Exercise:

Career-Awareness Assessment Tool

What is Career Assessment?

Career assessment is not a test; it is a series of assessments that offer an opportunity to expose what you like, your strengths, and needed areas of improvement for specific careers.

Do you enjoy chemistry	☐ yes | ☐ no
Do you desire to repair equipment	☐ yes | ☐ no
Do body fluids make you sick to your stomach	☐ yes | ☐ no
Do you have the aspiration to do hands-on work	☐ yes | ☐ no
Do laboratory and experiential work interest you	☐ yes | ☐ no
Do you enjoy direct patient care	☐ yes | ☐ no
Do you have the aspiration to use a microscope	☐ yes | ☐ no
Do you desire to investigate	☐ yes | ☐ no
Does science interest you	☐ yes | ☐ no
Do you enjoy working with people	☐ yes | ☐ no
Do you not enjoy working with people	☐ yes | ☐ no

Career and Education Planning Worksheet

Name: _____
Date: _____
Program/Class: _____
Teacher: _____

PART I – Self Exploration

My favorite school subjects are:

1. _____
2. _____
3. _____

My job and work values are: (Use worksheets from **Section II – Lessons 10, 11 on *Job Values***)

1. _____
2. _____
3. _____

Three skills I have are: (Use worksheets from **Section II – Lessons 6, 7, 8 on *Transferable Skills***)

1. _____
2. _____
3. _____

Three occupations that I would like to explore further that support my values are: (Use the worksheet from **Section III – Lesson 1 – Career *Exploration on the Internet***)

1. _____
2. _____
3. _____

PART II – Occupational Exploration

For each of the three occupations listed above, complete the following section: (Use the worksheet from Lessons on ***Career Exploration on the Internet, Job & Career Fairs,*** *and* ***Informational Interviews***)

Occupation Title:
_____

Average Annual Salary: _____
List some things that a person in this type of occupation does:
1._____

2._____

3._____

List some things that you know about the working conditions in this occupation. For example, does it require working outside or indoors, does it require sitting or standing all day?
1._____
2._____
3._____

This occupation matches my job values, interests, and skills in the following ways:
1._____
2._____
3._____

Jobs I am looking for now or in the future:

1. Where will I look? _____
2. Who will I talk to? _____
3. What do I hope to earn? _____
4. What contacts do I have to help me continue my education or get a job?

_____

PART III – New Skills

Three skills that I would need to develop for the occupations I am interested in are:

1. I will develop this skill by doing the following _____
2. I will develop this skill by doing the following_____
3. I will develop this skill by doing the following _____

PART IV – Education Planning

For each of the three occupations listed in Part I complete the following section:

1. What training or degrees do you need for this career?

_____

2. Do you need a license to work in this career? If yes, what license do you need?

_____

3. What educational steps do you need to take to prepare for this career?

_____

4. Where will you get it?_____
5. How long will it take?_____
6. What will it cost? _____
7. How will you pay for it? _____

PART V – My Goals

Use the SMART Goal worksheets from Section IV – Lesson 5 on *Setting Goals*)

Short term goal (6 months - 1 year):_____

_____

Long- term goal (2-5 years):

_____

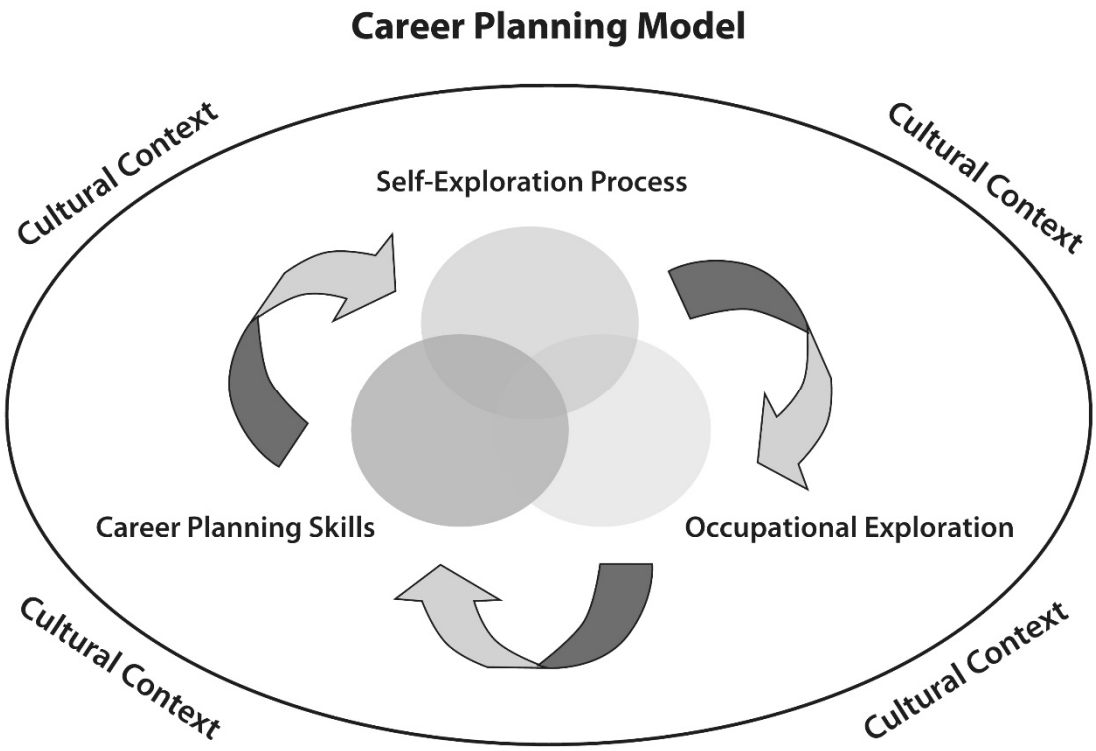
_____

Every long-term goal is made up of many short term goals and steps. As I get closer to my long-term goal I will set new short-term goals. The steps I need to take now to reach my long-term goals are:

Step	**Date to complete step**
1.	
2.	
3.	
4.	

3-day Professional Workshop for Science Teachers Materials and Resources

Day 2 Exercise:



Career and Education Planning Worksheet

Name: _____
Date: _____

Program/Class: _____
Teacher: _____

PART I – Self Exploration

My favorite school subjects are:

1. _____

2. _____

3. _____

My job and work values are (Use worksheets from **Section II – Lessons 10, 11 on *Job Values***)

1. _____

2. _____

3. _____

Three skills I have are (Use worksheets from **Section II – Lessons 6, 7, 8 on *Transferable Skills***)

1. _____

2. _____

3. _____

Three occupations that I would like to explore further that support my values are:
(Use the worksheet from **Section III – Lesson 1 – Career *Exploration on the Internet***)

1. _____

2. _____

3. _____

PART II – Occupational Exploration

For each of the three occupations listed above, complete the following section: (Use the worksheet from lessons on ***Career Exploration on the Internet, Job & Career Fairs,*** *and* ***Informational Interviews***)

Occupation Title:

_____

Average Annual Salary: _____

List some things that a person in this type of occupation does.

1._____

2._____

3._____

List some things that you know about the working conditions in this occupation. For example, does it require working outside or indoors, does it require sitting or standing all day?

1._____

2._____

3._____

This occupation matches my job values, interests, and skills in the following ways:

1._____

2._____

3._____

Jobs I am looking for now or in the future:

1. Where will I look?

_____

2. Who will I talk to?

_____

3. What do I hope to earn?

_____

4. What contacts do I have to help me continue my education or get a job?

_____

PART III – New Skills

Three skills that I would need to develop for the occupations I am interested in are:

1. _____

I will develop this skill by doing the following:

_____

2. _____

I will develop this skill by doing the following:

_____

3. _____

I will develop this skill by doing the following:

_____

PART IV – Education Planning

For each of the three occupations listed in Part I complete the following section:

What training or degrees do you need for this career?_____

_____

Do you need a license or certification to work in this career? If yes, what license do you need?

_____

What educational steps do you need to take to prepare for this career?

_____

Where will you get it?_____ How long it will it take?_____

What will it cost? _____ How will you pay for it?

_____

PART V – My Goals

Use the SMART Goal worksheets from Section IV – Lesson 5 on *Setting Goals*)

Short Term Goal (6 months - 1 year):_____

_____

Long Term Goal (2-5 years):

_____

Worksheet for Student Goal Scenarios

Name	Goal #1	Goal #2	Goal #3	Obstacles	Is it possible in one year?

Lesson Planning Template for High School Science Teachers

Class Type _____ Level _____

Total # hours of instruction per week_____ Total # of week's _____ Total # of CA hours_____

Lesson Title	Class Time	Preparation Needed	Curriculum Standards
Section I: The Cultural Context for Career Awareness			
Section II: The Self-Exploration Process			
Section III: Professional/Occupational Exploration			
Section IV: Career Planning Skills			
How will you collaborate or coordinate with other program staff to prepare to			

Job Values Inventory for High School Science Students

This exercise helps you identify which job qualities you value most.

Rank the items below from 1 to 12 with 1 being most important and 12 the least important. Once you begin exploring job possibilities, focus only on jobs that meet your highest ranked values.

_____ Good salary
_____ Good benefits (insurance, retirement, etc.)
_____ Job security
_____ Work hours that meet your needs
_____ Satisfactory location
_____ Compatible coworkers, supervisors, customers
_____ Opportunity to learn and develop skills
_____ Challenging and satisfying work
_____ Good working conditions / environment
_____ Like / believe in what the organization does
_____ Chance for promotion / advancement
_____ Career advancement
_____ Prestige and respect

Adapted from the California Career Planning Guide 2003–2005

Work Values Clarification

On your own, brainstorm answers to the following questions.

1. What are three values that your parents held?

   a.

   b.

   c.

2. What are three values that you think teachers in schools hold?

   a.

   b.

   c.

3. What are three values that you believe most employers hold?

   a.

   b.

   c.

4. What are three values that your friends hold?

   a.

   b.

   c.

Adapted from "Personal Management: An Integrated Curriculum," Patti McLaughlin, Curriculum Developer, Adult Basic and Literacy Educators Network of Washington, 1993.

3-day Professional Workshop for Science Teachers Materials and Resources

Day 3 Exercise:

Career Exploration of Clinical Laboratory Science (CLS) on Internet Work Description and Working Conditions

1. What does a _____ do on a daily basis?
2. In what kind of setting do they work? Inside or outside?
3. How many hours a day do they work?
4. Does _____ work alone or with other people?
5. What kind of equipment does a _____ use? (i.e., computer, x-ray machine, forklift, etc.)
6. Are there any physical or health considerations concerning this work?
7. Other questions?_____

Wage/Salary

1. What is the typical starting salary of a CLS?
2. Other questions?_____

Employment Outlook

1. What is the employment outlook for a CLS?
   _____
2. Are there many jobs in this occupation near where I live?
   _____
3. Is part-time employment usually available in this occupation?
   _____

Career Path and Opportunities for Growth

1. What are the opportunities for advancement in this occupation?
2. Other questions?_____

Education Requirements, Licensure/Certification

1. What education and/or training are required to become a _____?
2. Where do I go to school or get training in my area to become a _____?
3. What is the best school for _____?
4. Does this occupation require licensure or certification? _____
5. Other questions? _____

What is Clinical Laboratory Science?

Info

The Profession of Clinical Laboratory Science

Clinical laboratory science, also called medical technology, is the health profession that provides laboratory information and services needed for the diagnosis and treatment of disease. Clinical laboratory scientists perform a variety of laboratory tests, ensure the quality of the test results, explain the significance of laboratory tests, evaluate new methods, and study the effectiveness of laboratory tests. Examples of laboratory tests performed by clinical laboratory scientists include:

- the detection of the abnormal cells that cause leukemia
- the analysis of cardiac enzyme activity released during a heart attack
- the identification of the type of bacteria causing an infection
- the detection of DNA markers for genetic diseases

Careers in Clinical Laboratory Science

A Degree in Clinical Laboratory Science opens a window of exciting career opportunities.

CLS graduates can be found working as:

- Clinical laboratory generalists in hospitals, clinics or commercial laboratories.
- Clinical laboratory specialists working in areas such as microbiology, hematology, blood bank, chemistry, molecular biology/DNA, histocompatiblity, virology, immunology/serology, stem cell/bone marrow labs, and flow-cytometry.
- Clinical laboratory supervisors, managers, administrators and directors.
- Quality assurance/quality management specialists in hospitals or industry (e.g. pharmaceutical quality operations).
- Technical representatives, sales representatives or research and development specialists in laboratory industries.
- Clinical research associates (CRA) in clinical trials organizations.
- Research technologists or research supervisors/coordinators in academic medical centers.
- Laboratory information systems specialists.
- Infection control officers in hospitals or clinics.
- Educators for employee training programs or formal academic programs.
- Consultants for physician office laboratories.
- Forensic scientists in governmental or commercial laboratories.
- Clinical laboratory scientists in veterinary laboratories.

Educational Requirements of a Clinical Laboratory Scientists

In the United States, a clinical laboratory scientist (CLS), or medical technologist (MT) typically earns a bachelor's degree in clinical laboratory science, biomedical science, medical technology, or in a life / biological science (biology, biochemistry, microbiology, etc.), in which case certification from an accredited training program is also required. In most four-year medical laboratory degree programs, the student attends classroom courses for three years and clinical rotations are completed in their final year of study. In clinical rotations, the student experiences hands-on learning in each discipline of the laboratory and, under supervision, performs diagnostic testing in a functioning laboratory. With limited or no compensation, a student in the clinical phase of training usually works 40-hours per week for 20 to 52 weeks, experiencing work as a full-time employee.

In the United States, a similar 2-year degree qualifies the graduate to work as a clinical laboratory technician (CLT). Depending on the state where employment is granted, the job duties are very similar, but CLTs receive training more exclusively in laboratory sciences without the basic science coursework the CLS often takes. The shorter training time is attractive to many students, but there are disadvantages to this route. For example, MTs, MLSs, and CLSs usually earn higher salaries than MLTs, and some institutions do not employ MLTs at all.

In the United States, the term *medical laboratory technician* (MLT) may apply to persons who are trained to operate equipment and perform tests under the supervision of the certified medical technologist or laboratory scientist in their departments. The entry-

level for most medical laboratory technicians is an associate degree, and some states require license, which can be acquired after completing necessary education and clinical requirements.

In Canada, three-year college programs are offered that include seven semesters, two of them comprising an unpaid internship. The student graduates before taking a standard examination (such as the Canadian Society for Medical Laboratory Science, or CSMLS, exam) to be qualified as a medical laboratory technologist. Many MLTs go on to receive a Bachelor of Science degree after they are certified, but a few university programs affiliate with a college MLT program to allow students to graduate with both MLT certification and a degree.

Certification and Licensing

In the United States, the Clinical Laboratory Improvement Amendments (CLIA '88) define the level of qualification required to perform tests of various complexity. Clinical laboratory scientists, medical technologists, and medical laboratory scientists are the highest level of qualification and are generally qualified to perform the most complex clinical testing, including HLA testing (also known as tissue typing) and blood type reference testing.

In addition to the national certification, 12 states (California, Florida, Georgia, Hawaii, Louisiana, Montana, Nevada, North Dakota, Rhode Island, Tennessee, West Virginia, and New York) and Puerto Rico also require a state license. In Puerto Rico, in order to provide the state license, either a local board certification with a state examination or any of both the ASCP and the NCA certifications are required.

Minnesota, Texas, Illinois, Massachusetts, Michigan, Vermont, Washington, New Jersey, Iowa, Utah, Ohio, South Carolina, Wyoming, Pennsylvania, Virginia, South Dakota, Delaware, Missouri, and Alaska are currently attempting to obtain licensure. All states require documentation from a professional certification agency before issuing state certification. A person applying for state certification may also be expected to submit fingerprints, education and training records, and competency certification. Some states also require completion of a specified number of continuing education contact hours prior to issuing or renewing a license. Some states, such as California, Florida, and Tennessee, recognize another state's license if it is equal or more stringent, but currently California does not recognize any other state license.

Comparing CLS Schools: What is Important to You?

List the issues or topics that are importance to you, for example, tuition, location, degree programs. Use this worksheet to help you gather and record the information.

School	***Topic 1***	***Topic 2***	***Topic 3***	***Topic 4***
1.				
2.				
3.				
4.				

Appendix B: National Institutes of Health Certificate

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Cynthia Doby** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/05/2011

Certification Number: 742995

Appendix C: IRB Material Approval

Subject: IRB Materials Approved-Cynthia Funnye-Doby
Date: Wed, Dec 04, 2013 11:02 AM CST

Attachment ✔Funnye-Doby_Cynthia_Consent_Form_Clinical_Scientists.pdf
✔Funnye-Doby_Cynthia_Consent_Form_College_Students.pdf
✔Funnye-Doby_Cynthia_Consent_Form_High_School_Students.pdf

Dear Ms. Funnye-Doby,
This e-mail is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "The Relationship Between Lack of Awareness of the Profession of Clinical Laboratory Science and the Shortage of Clinical Laboratory Scientists in the Twenty-First Century."

Your approval # is 12-04-13-0172253. You will need to reference this number in your doctoral study and in any future funding or publication submissions. Also attached to this e-mail is the IRB approved consent form. Please note if this is already in an on-line format, you will need to update that consent document to include the IRB approval number and expiration date.

Your IRB approval expires on December 3, 2014. One month before this expiration date, you will be sent a Continuing Review Form, which must be submitted if you wish to collect data beyond the approval expiration date.

Your IRB approval is contingent upon your adherence to the exact procedures described in the final version of the IRB application document that has been submitted as of this date. This includes maintaining your current status with the university. Your IRB approval is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, your IRB approval is suspended. Absolutely NO participant recruitment or data collection may occur while a student is not

If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB application, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden web site or by e-mailing irb@waldenu.edu: http://researchcenter.waldenu.edu/Application-and-General-Materials.htm

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Please note that this letter indicates that the IRB has approved your research. You may not begin the research phase of your doctoral study, however, until you have received the Notification of Approval to Conduct Research e-mail. Once you have received this notification by e-mail, you may begin your data collection.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Alex Dohm
Research Service Specialist
Center for Research Quality
Walden University
100 Washington Avenue South, Suite 900
Minneapolis, MN55401

Follow us on Twitter for research resources and tips!
Twitter: @WaldenResearch
https://twitter.com/WaldenResearch

Appendix D: Letter of Cooperation

Thank you for agreeing to participate in the interview session. The interviews should take 45-90 minutes. This research is part of an EdD project study in Higher Education and Adult Learning (HEAL) at Walden University. The increase in baby boomers retiring from the profession of clinical laboratory science (CLS) will cause a significant shortage of competent laboratory scientists in the profession. The purpose of the research is to explore the relating factors that exist between lack of awareness and shortage of Clinical Laboratory Scientists in the New Generation. For the purposes of this research "clinical laboratory scientists" also called Medical Technology, is the health profession that provides laboratory information and services needed for the diagnosis and treatment of disease. Clinical Laboratory Scientists perform a variety of laboratory tests, ensure the quality of the test results, explain the significance of laboratory tests, evaluate new methods and study the effectiveness of laboratory tests. Examples of laboratory tests performed by Clinical Laboratory Scientists include: 1) the detection of the abnormal cells that cause leukemia, 2)the analysis of cardiac enzyme activity released during a heart attack, 3) the identification of the type of bacteria causing an infection, and 4) the detection of DNA markers for genetic diseases.

By printing your name and signing at the bottom, you are agreeing to cooperate in this research. This research will be approved by the Institutional Review Board (IRB) of Walden University prior to any data being collected. The signed informal letter will be collected and seen only by the researcher and will be kept in a locked filing kept and will be destroyed after 5 years.

There is no reward for participating in this research. The participants in the study are assured there are no conflicts of interests for participating in the study, no one will be paid to conduct this research including the researcher or the participants, nor will anyone receive any benefit or consequence from choosing to take part or not in the project study. Individuals that will be chosen will not any direct reports to the researcher. The participants will be chosen from the main hospital laboratory or students that are not enrolled in the researchers courses for the semester. It is unlikely that there will be any discomfort, embarrassment, or bad memories that could occur from participating. Benefits include deeper reflection about the CLS profession or career, making one aware of the profession and or perceptions that exists, and lastly a contribution to research. The researcher will also provide a letter of recommendation to any participants whom need one for any college, university, or scholarships. On the last page is a place for you to provide your name and contact information ONLY if you would like to participate in an interview. The interview will be held at your convenience in the new few months. Otherwise, you do NOT need to print and sign your name. Return: Please place your signed formal letter in the self-addressed (postage included) envelope and drop off in any U.S. postal location. Otherwise, notify the researcher and a meeting can be arranged for the informal letter to be e-mail/scan, fax, or picked up at any location. If you have any

questions or concerns about this research or if you would like a copy of the results, contact me.

Appendix E: What Is Clinical Laboratory Science?

The Profession of Clinical Laboratory Science

Clinical Laboratory Science, also called Medical Technology, is the health profession that provides laboratory information and services needed for the diagnosis and treatment of disease. Clinical Laboratory Scientists perform a variety of laboratory tests, ensure the quality of the test results, explain the significance of laboratory tests, evaluate new methods and study the effectiveness of laboratory tests. Examples of laboratory tests performed by Clinical Laboratory Scientists include:

- the detection of the abnormal cells that cause leukemia
- the analysis of cardiac enzyme activity released during a heart attack
- the identification of the type of bacteria causing an infection
- the detection of DNA markers for genetic diseases

Careers in CLS

A Degree in Clinical Laboratory Science opens a window of exciting career opportunities. CLS graduates can be found working as:

- Clinical laboratory generalists in hospitals, clinics or commercial laboratories.
- Clinical laboratory specialists working in areas such as microbiology, hematology, blood bank, chemistry, molecular biology/DNA, histocompatibility, virology, immunology/serology, stem cell/bone marrow labs and flow cytometry.
- Clinical laboratory supervisors, managers, administrators and directors.
- Quality assurance/quality management specialists in hospitals or industry (e.g. pharmaceutical quality operations).
- Technical representatives, sales representatives or research and development specialists in laboratory industries.
- Clinical Research Associates (CRA) in clinical trials organizations.
- Research technologists or research supervisors/coordinators in academic medical centers.
- Laboratory information systems specialists.
- Infection control officers in hospitals or clinics.
- Educators for employee training programs or formal academic programs.
- Consultants for Physician Office Laboratories.
- Forensic scientists in governmental or commercial laboratories.
- Clinical laboratory scientists in veterinary laboratories.

Appendix F: Focus-Group Questions

Section 1: High School Students (Focus-Group Questions)

Q1: What do you know about the Clinical Laboratory Science (CLS) field?

Q2: What do you think a Clinical Laboratory Science (CLS) professional does on a daily basis?

Q3: What type of jobs do you think are available in the CLS field?

Q4: What type of pay do you think a CLS clinician makes?

Section 2: College Students (Focus-group Questions)

Q1: What attracted you to the Clinical Laboratory Science field?

Q2: Social factors (networking, friends, and family) that may have made it sound attractive?

Q3: Financial reasons?

Q4: How did you hear about the Clinical Laboratory Science field?

Q5: At what age did you consider the CLS field as a career choice seriously?

Q6: What courses in high school may have helped peak your interest in the CLS field?

Q7: Did you hear about CLS through your own investigation or because of recommendation from others?

Appendix G: Individual Interview

Section 1: CLS Professionals

Q1: What attracted you to the Clinical Laboratory Science field?

Q2: Social factors (networking, friends and family) that may have made it sound attractive?

Q3: Environmental factors? (aging population, shortage of CLS)

Q4: Financial reasons?

Q5: Self-efficacy?

Q6: Goals/options?

Q7: How does the CLS field compare as a career to other allied health fields?

Q8: What are the factors that contribute to your continued interest in the CLS field? In other words, why have you remained in the field?

Q9: What are the factors that would cause you to leave the CLS field?

Q10: Do you feel that there is a shortage of CLS workers?

A: If so, how has it affected patient:

1. Service?
2. Outcomes?

B: How has it affected your personal workload?

Q11: How do you foresee a greater shortage of CLS workers affecting patient care in the future?

Q12: How do you foresee a greater shortage of CLS workers affecting workload in the future?

Q13: How do you foresee a greater shortage of CLS workers affecting lab result turnaround time in the future?

Appendix H: Coding of Data

Table A6

Coding for Research Question 1

	Participant 1		Participant 2	
Theme	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Draw blood	2	Drawing blood, stomach surgery is what I think a CLS does daily. Drawing blood, stomach surgery is what I think is available in the CLS field.	2	I think the CLS draw blood and run tests for the lab. The type of job I think that are in the CLS field is drawing blood, running test and person who prepares for all testing.
Run tests			2	I think the CLS draw blood and run tests for the lab. The type of job I think that are in the CLS field is drawing blood, running test and person who prepares for all testing.
Don't know	1	I do not [know] anything about the CLS work field.	2	I do not know anything about the field of CLS. I think still not too sure.
Surgery	2	Drawing blood, stomach surgery is what I think a CLS does daily. Drawing blood, stomach surgery is what I think is available in the CLS field.		

Table A6 Cont.

Coding for Research Question 1

	Participant 3		Participant 4	
Theme	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Draw blood	2	Work with human body like drawing blood and surgery. Drawing blood for surgery and doctor offices.	1	Run tests, as in drawing blood.
Run tests			3	Run tests, as in drawing blood. They have people to take a numerous amount of tests, Running diagnosis and other tests.
Don't know	1	I do not know anything about a CLS field or profession. Nothing at all.		
Surgery	2	Work with human body like drawing blood and surgery. Drawing blood for surgery and doctor offices.		

Table A6 Cont.

Coding for Research Question 1 continued

Participant 5				
Theme	# Mentions	Exemplar quotes	N mentioning	Total exemplar quotes
Draw blood			4	7
Run tests	1	I think they run scans and test for clinical problems like mental and physical conditions.	3	6
Don't know	1	I do not know anything about the CLS field	4	5
Surgery	1	Nursing jobs, doctor jobs, and surgical jobs, lab jobs, and analyst	3	5

Table A7

Coding for Research Question 2

	Participant 6		Participant 7	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Science	1	Biology, my high school did not offer any advanced sciences courses.		
Own investigation	1	I found out about CLS through my own interest.		
Healthcare	1	Having the opportunity to play a role in the patients' healthcare in a "behind the scenes" sort of way.		
Family in healthcare	1	Family--my family is all in the medical field	2	The passion my cousin has for this field made it sounds attractive. My older cousin is a CLS & that made me interested in learning about it. I had never heard of it before her.

Table A7 Cont.

Coding for Research Question 2

	Participant 8		Participant 9	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Science	2	None at the time, I was in high school because I had never heard of the field, but looking back on it, I always liked chemistry and biology. I always liked science and working with tangible things.	2	I have always been interested in Science. In high school, I loved Biology, Physical Science Chemistry. I have always had an interest in Science. As I progressed in my studies, I began to learn about different fields of Science.
Own investigation	2	My own investigation I hated my major at the time which was Communication Science and Disorders, and I knew I liked science, so I got on ISU's website and did a "control + F" search of the Academic Majors page for the word "science." Medical Laboratory Science was listed, and I had never heard of it before so I checked it out and decided to switch.	1	I heard about Clinical Laboratory Science, through my own research as a Science major in Undergrad.
Healthcare	1	I also wanted to be in healthcare and help people, but I did not want to have a lot of direct patient contact.	2	After reading and researching Clinical Laboratory Science, I felt it would definitely be a field that would interest me, and I felt I would learn a lot, and eventually be able to help people with my knowledge. As far as social factors, I know that there are a lot of diseases and illnesses that have affected my family and friends, so in regards to Clinical Laboratory Science, I could one day be a part of a research team to help with a cure for any of the many diseases and illnesses that exist.
Family in healthcare				

Table A7 Cont.

Coding for Research Question 2 continued...

	Participant 10			
	# Mentions	Exemplar quotes	N mentioning	Total exemplar quotes
Science	1	Chemistry, Biology, Anatomy & Physiology	4	6
Own investigation	2	I then did some independent research, and upon investigation, I felt that Clinical Laboratory Science fit perfectly with what I wanted to do as a career. My undergrad advisor told me about it and I did some independent research.	4	6
Healthcare			3	4
Family in healthcare			2	3

Table A8

Coding for Research Question 3

	Participant 11		Participant 12	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Negative factors of CLS				
Understaffed				
More Work			1	The workload on a single tech has increased very much so.
Errors				
Lower quality care			1	I see labs training personal (on the job). These employees do not have a full comprehension of the testing they are performing because of the automation. There is not appropriate investigation into abnormal results because of this.
Underpaid	1	Many people do not know what we do or what educational background we have. I also feel that we are underpaid compared to nurses or other allied health field positions.	1	I feel the pay is less than other jobs that have more patient contact.
Not respected	2	Many people do not know what we do or what educational background we have. I also feel that we are underpaid compared to nurses or other allied health field positions. Compared to other allied health fields I do not feel that we are respected as a profession		
Lack career growth			1	Many times to advance you have to leave the lab and go into a company's sales or diagnostic area.
Factors that attracted to CLS				
Science			1	I enjoyed the lab portion of the science classes that I took in college. . I also liked to see a solution or an outcome from the labs.

Table A8 Cont.

Coding for Research Question 3

High demand	1	They explained how the CLSI field was highly in demand due to the age group of laboratory employees.	1	There appeared to be many job openings and stability in the field also.
Healthcare				
Good pay				
Factors to stay in CLS				
Help others				
Interesting work			1	I have found learning the different departments interesting and the job fit my lifestyle

Table A8 Cont.

Coding for Research Question 3 continued

	Participant 13		Participant 14	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Negative factors of CLS				
Understaffed	1	I do feel there is a shortage.	1	Yes, there is definitely a shortage of laboratory professionals. When we have openings in our lab, we typically have to wait for our students to graduate to be able to fill them.
More Work	1	I have been required to multi task more often, assist co-workers, especially the older ones, in keeping up with the increase in work due to the shortage.		
Errors	2	Pre analytical errors, analytical errors, and post analytical errors will increase. Too much on the workload will only increase lab errors, which will ultimately affect the care and treatment provided to the patients.		
Lower quality care				
Underpaid	3	However, now that I am in the field, compared to other allied health professionals, I do not agree. Many current CLS will leave the field because of pay in comparison to such an increase workload. The pay and job growth opportunities would cause me to leave the CLS field.	1	Even though it is a rewarding career the lack of visibility resulting in inequitable salaries is concerning. It is difficult to justify the fact that some associate degreed allied health professions have a higher entry-level salary.
Not respected	1	Since CLS is so behind the scene, it is not respected or recognized as much as other allied health careers.	1	Even though it's a rewarding career the lack of visibility resulting in inequitable salaries is concerning

Table A8 Cont.

Coding for Research Question 3, Participant 13 and 14 continued

	Participant 13		Participant 14	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Lack career growth	2	The pay and job growth opportunities would cause me to leave the CLS field. Early in my career, I felt there would be many growth opportunities. However, I do not feel the same anymore.		
Factors that attracted to CLS				
Science	1	What initially attracted me to Clinical Lab Science was the forensic science specialty.	2	I also loved my lab courses in high school then heard about the field during a career day. It was a perfect fit with my interests in science and healthcare.
High demand	2	It was told to me that the current CLS would soon be retiring and that a shortage was at hand. It was easy to find jobs to apply for and I was even hired before I graduated.		
Healthcare			2	It was a perfect fit with my interests in science and healthcare. I was interested in a healthcare field with minimal patient contact.
Good pay	1	Financially, during the course of my studies I was told that the pay was great.		
Factors to stay in CLS				
Help others				
Interesting work	1	I have remained in the field so far because of the job stability and to continue to increase my knowledge base in CLS information.	1	Even though I am not practicing at the bench I think the fact that the field is continually evolving and that it's never dull, there's no shortage of interesting patient results

Table A8 Cont.

Coding for Research Question 3, Participant 15/16

	Participant 15		Participant 16	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Negative factors of CLS				
Understaffed	1	YES	1	Yes, I do believe there is a shortage of CLS workers.
More Work			2	As mentioned, understaffing can lead to decrease in productivity, overworked, burned out employees, less accuracy and attention to detail contributing to mistakes and errors that could have been avoided. It decreased the quality of care. The shortage of CLS has affected my personal workload by not having enough staff to cover my schedule
Errors	3	Overworked and stressed lab workers introduce a higher probability of mistakes/testing inaccuracy. Longer patient stays, misdiagnosis. Even when CLS workers are competent, the overworked/ stressed environment introduces mistakes. I must constantly reevaluate to train ways to prevent mistakes.	1	As mentioned, understaffing can lead to decrease in productivity, overworked, burned out employees, less accuracy and attention to detail contributing to mistakes and errors that could have been avoided. It decreased the quality of care.
Lower quality care	1	It will continue to affect patient outcomes. Right now, the problem seems small and isolated but as more CLS workers retire and less enter the field, we will see a huge impact.	2	I foresee a decrease in the quality of patient care as a result of a shortage of CLS. 1Having a shortage of CLS workers affect service by lack of qualified, competent personnel to perform the required job duties. This in essence is what leads to understaffing.
Underpaid	1	People do not really know what we do and they do not think it requires any degree. We are less valued and it shows by the level of respect we get within healthcare institutions, the lack of knowledge about the profession, the lack of pay compared to allied health professions that only require and associates degree etc.	1	Factors that would cause me to leave the CLS field will include but not limited to, decrease in pay, increased dependence on automation, lack of organizational structure (i.e. no managers or directors), decrease in educational requirements or certification, to advance to another career.

Table A8 Cont.

Coding for Research Question 3, Participant 15/16 continued

	Participant 15		Participant 16	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Not respected	1	People do not really know what we do and they do not think it requires any degree. We are less valued and it shows by the level of respect we get within healthcare institutions, the lack of knowledge about the profession, the lack of pay compared to allied health professions that only require and associates degree etc. We are behind the scenes, but play a major role in health diagnosis and outcomes.	1	We work behind the scenes and seem to be forgotten and not appreciated for what we do.
Lack career growth			1	Factors that would cause me to leave the CLS field will include but not limited to, decrease in pay, increased dependence on automation, lack of organizational structure (i.e. no managers or directors), decrease in educational requirements or certification, to advance to another career.
Factors that attracted to CLS				
Science				
High demand			1	Environmental factors that contributed to my decision to become a MT were the aging population of MTs as well as the shortage. The Bureau of Labor statistics as well as studies conducted by ASCP predicted a shortage of medical technologist entering the field due to a lack of knowledge of the career, closing of MT programs, and retiring population. Therefore, the job outlook was good, being in demand.
Healthcare	1	I have always wanted to be in the medical profession. I started out as a Pharmacy major but realized that it did not really fit for me.	1	My career goal has always been to help others in some way in the medical field. I originally wanted to become a physician.

Table A8 Cont.

Coding for Research Question 3, Participant 15/16 continued

	Participant 15		Participant 16	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Good pay			1	At the time I learned about the career of being a medical technologist, I lived in California. California is one of the few states that pay the highest salary for MTs. Therefore, I was impressed with the career and the potential to make good money. However, I relocated to upstate NY, and the pay was much less, as is here in the Midwest.
Factors to stay in CLS				
Help others	3	The belief that what we do in the laboratory greatly affects patient care. I felt and do still feel that I can make a difference in the positions I have held within the profession. I do not think that I would ever permanently leave the field. I enjoy it and believe in what we do.	2	I remained in the field because I understand the importance of what we do, and our purpose. I enjoy knowing that my responsibility of ensuring the accurate, timely reporting of pertinent laboratory results will ultimately affect the patients' treatment and care. I am still satisfied with being a MT because I know that my job indirectly have an impact on treatment and patient care.
Interesting work	1	Constantly being able to educate myself on tests and diagnosis correlation, instrumentation troubleshooting and methodologies has always kept me interested.		

Table A9

Coding for Research Question #4

	Participant 17			
	# Mentions	Exemplar quotes	N mentioning	Total exemplar quotes
Negative factors of CLS				
Understaffed			4	4
More Work	2	We now expect fewer CLS workers to accommodate the same number of patients….in a shorter time. Because of fewer workers, we have seen an increased wait time and having a direct impact on lab results § Unfortunately, my workload has increased (without increased pay of course!). I find myself working 10 – 12 hours a few days out of the week.	4	6
Errors			3	6
Lower quality care			3	4
Underpaid			6	8
Not respected			5	6
Lack career growth			3	4
Factors that attracted to CLS				
Science	1	• I have always been intrigued with Science, even as a child.	4	5
High demand			4	5
Healthcare			3	4
Good pay	1	• The pay is not bad…could be better of course! There are several people that had their student loans forgiven after joining this field.	3	3
Factors to stay in CLS				
Help others	1	We may be behind the scenes, but to be a part of something so important and possibly life altering (from processing bodily fluids to diagnosing health issues), it is difficult to describe.	3	6
Interesting work			4	4

Table A9 Cont.

Coding for Research Question 4 continued

	Participant 11		Participant 12		Participant 13	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Delay					3	Not getting results out in a timely manner. This can cause a delay in patient care, patient diagnosis, and patient treatment. Ultimately, health care providers rely on the timely and accurate lab results provided by CLS. If the shortage continues, this will be greatly impacted in a negative way.

Coding for Research Question 4 continued

	Participant 14		Participant 15	
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes
Delay	1	However, as the work short staffed it can influence turnaround times if holes in the schedule are not filled.	1	Turnaround times are affected as well as the ability to bring testing in-house.

Coding for Research Question 4 continued

	Participant 16		Participant 17			
	# Mentions	Exemplar quotes	# Mentions	Exemplar quotes	N mentioning	Total exemplar quotes
Delay					3	5