QATAR UNIVERSITY

COLLEGE OF HEALTH SCIENCES

EVALUATION OF LABORATORY CLINICAL TRAINING INTERNSHIP OF A

NAACLS ACCREDITED PROGRAM IN QATAR: GRADUATES PERSPECTIVE

BY

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# ABSTRACT

Aarti Sharma, Master of Science: April: 2021, Biomedical Sciences

Title: Evaluation of Laboratory Clinical Training Internship of a Naacls Accredited Program in Qatar: Graduates Perspective

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**Background:** The medical laboratory educational programs (Medical Laboratory Science and Medical Laboratory Technology) accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) provide the graduates with the required knowledge and skills for working in laboratory settings. This study explored the graduate's satisfaction in relation to content, clinical instructors, skills gained during clinical training, and applied in their workplaces. In addition, students gave their opinions and suggestions to improve the clinical training from their perspective.

**Methods:** The survey enrolled BMS graduates from Qatar University during the period from 2015-2020. The students answered survey questions via telephone interview. The analysis was performed using SPSS ver26.

**Results:** The descriptive analysis showed a high satisfaction rate of 80 % for the content and organization of clinical training. A 70 % satisfaction rate was found in terms of evaluation criteria and the length of clinical training. The satisfaction rate was more than 50 % related to the clinical instructors. A minimal of 2.6% of students were not satisfied with the instructors during training. In cognitive domain graduates the skills related to safety management, working on infectious materials, and quality control were well derived by 53.9% students. On the contrary, skills related to financial management, budgeting, and HR laws were not derived by 49.6% of graduates. In the psychomotor

domain, 33.1% of students derived very well capacity associated with information and communication technology however, skills related to research; planning, and designing experiments were the least derived skills. Only less than 8% claim to have never learnt skills in the affective domain. Furthermore, a comparison of skills derived and used in three domains; Cognitive, psychomotor, and affective using non-parametric test; showed discrepancies in skills derived and used in the psychomotor and affective domain (p-value <0.000). Comparison between the derived cognitive, psychomotor and affective skills with the job title illustrated that these skills were more applied by graduates working in diagnostic settings compare to those working in non-diagnostic lab settings.

**Conclusion:** Qatar University graduates were satisfied with the content of clinical training. However, skills of the psychomotor domain and affective domain had discrepancies in deriving and further application at workplaces. Our results further concluded that the skills derived in three domains were well used by graduate working in diagnostic lab settings more than to those working in non-diagnostic lab settings. Identifying the gap areas in clinical training and bridging these gaps will help in restructuring the clinical training to improve student experience.

# DEDICATION

*I dedicate my thesis to my husband Vikas for his continuous support to make everything possible and to my children Vanya and Veer for their love, affection, and patience during these two years and always.*

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CHAPTER 1: INTRODUCTION

*1.1 Introduction*

The Clinical Training Curriculum is the oldest of all health professional-related training programs. The objective of this program is to develop the skills of medical laboratory scientists (MLS) and medical laboratory technologists (MLT) to work in laboratory settings. At John Hopkins Hospital, the practice of being a laboratory technologist started in 1896. This laboratory was run by physician's and they performed the laboratory testing procedures themselves (Stanley, 1990). According to (Delwiche, 2003) after World War 1, clinical training courses were set up to train medical laboratory technologists to perform laboratory testing. As no separate schools or courses were established, the majority of laboratory personnel received training in hospitals. The training provided was equivalent to what is now termed as On-Job Training.

This hospital training served as an investment in the laboratory work field in terms of expert lab personnel, more investment and entry-level. Until 1960, youth talent for labs continued their training in hospital schools. With the advent of new diseases and complicated tests, healthcare professionals felt the need for formal education after the 1960s as laboratory work became more complicated.

Therefore, an integrated system of formal college education and clinical practice has been implemented to provide qualified and well educated MLT and MLS courses. The MLTs and MLSc were qualified to work in all areas of clinical and they could perform all sets of simple to complex tests. They were also qualified to send to pathologists or physicians the laboratory results. In 1922, American Society for Clinical Pathologists (ASCP) was established to develop standardized medical education (ACSP, 2020). Further, as per (Delwiche, 2003), ASCP founded the Board of Registry

(BOR) to certify laboratory technologists in order to standardize laboratory personnel education, in 1928.

The bachelor's degree in biomedical sciences (BMS) department was established at Qatar University in 1984, in collaboration with Qatar's leading health agencies, to provide students with practical laboratory sessions and clinical internships to facilitate a career path for students in diagnostic laboratories and research.

In the last semester of the biomedical sciences graduate course, there is a mandatory internship program. Students are required to complete five courses of clinical practice in 15 weeks. This course of clinical practice is conducted in collaboration with Hamad Medical Corporation (HMC). The aim of this unique internship program is to provide actual clinical laboratory experience and quality education in various laboratory specializations, including hematology, immunology, clinical chemistry, and microbiology.

The BMS graduate program is accredited by NAACLS and also fulfills the ASCP (American Society for Clinical Pathology) certification requirement as graduates are encouraged to get an ASCP certification at the earliest after completing the degree. However, it is only possible to pursue a rewarding professional career if graduates are able, not able to apply practical knowledge from internship programs in their working environment.

*Problem Statement*

Internship programs are referred to as the first career experience offered by universities to graduates. These internship programs allow graduates to transition from school to job. Later, a good internship program provides satisfied employees and experienced workers. In addition, as per NAACLS, it helps to maximize the likelihood of BMS graduate employability with the knowledge and skills required by the labor

market. In graduate clinical training programs, a foundation for entry into professional employment is provided with last semester's clinical training programs. The graduates get practical experience in multiple laboratories during these clinical rotation courses. This helps them to understand the laboratories' real workflow.

At Qatar University, students are provided with a clinical rotation course in different laboratories. This helps students to be competent and productive at their workplaces. However, the level of satisfaction of students after completing their training has not been measured or studied. This project seeks to understand and highlight discrepancies between the skills acquired through this training program and the practical skills needed to work in modern clinical laboratories, thus providing a measure of graduate perspective to establish a more comprehensive program of clinical training.

*1.2 Research Objectives*

The aim of this study is to evaluate the graduate viewpoint on the internship program and its application at the professional level. Therefore, our objectives are:

1.     To analyze the satisfaction level of biomedical laboratory science graduates with the clinical training internship program.

2.     To address whether there is a discrepancy between the skills derived during clinical training and application of these skills in their respective jobs.

CHAPTER 2: LITERATURE REVIEW

*2.1 A systematic review of the laboratory set up inside hospital settings*

Laboratory learning refers to learning which begins and occurs either independently or collaboratively in an environment where learners can examine, exercise, and explore with exhibits, resources, experiments, and concepts. This education is not restricted to single classroom space, it can also take place in other types of learning, such as the e-learning control system and virtual laboratory replicated by software.The diagnostic techniques have become more complex with advancement of technology and evolution of medicine (Berger, 1999)

As eyes and ears were only the sources of diagnosis for the physicians so the physicians mastered the technique to analyze the body fluids using these senses only. The most commonly used and mastered technique was uroscopy (Ehrenkranz, 2002). In this technique, urine was spilled on the ground and observed to see whether insects were drawn to it.

Chronic kidney diseases were also diagnosed with the presence of bubbles on the surface of urine samples. Hippocrates correlated the disease with some urinary sediments and blood and pus in the urine. Thus, in absence of diagnostic techniques and a microscope, the physicians made diagnosis for patient's ailments using above mentioned techniques.

As the human race progressed towards the 17 centuries, the microscope was invented. Findlen (2004), was first to look into the cause of the disease in the mid 17th century with a microscope. The microscope was later used by Robert Hooke stating the presence of cells and later microbiological investigations were carried out in medical field.

As scientific knowledge progressed towards the 18 century the field of medicine

transferred from theoretical to practical. In this golden age of medicine, new types of diseases along with new drugs were discovered. Many diagnostic tools including advanced microscopes, X-ray, bacteriological and chemical tests marked their beginning in the 19th century (Hajdu, 2019). These new tools and technologies generated data based on patient physiology. The physicist now began to rely on diagnostic techniques and tools and moved away from sensory forces.

Among these tools, the Microscopes helped to discover the cellular and microbial environment in the 19th century. Professor Johannes Evangelista Purkinje a Bohemian was the pioneer for using the microscope and taught microscopy as a part of university course at the University of Breslau in 1823. Later, he began a physiological laboratory in his house. In the mid-1800s, laboratory testing was introduced for diseases like diphtheria, cholera, tuberculosis, and typhoid (Mazurak & Kusa, 2018).

After the house laboratory settings, the 19 centuries saw the advent of sophisticated diagnostic tools and laboratories globally. The hospital laboratory set up at Guy's hospital in Britain had two wards; one for rotation of medical students and a small clinical laboratory (Peek et al., 2018). In the USA, physicians used to conduct the microscopic test themselves with a microscope installed at home or office.

In Europe labs with various disciples; pharmacy, forensic, public health, microbiological emerged by the early 1900s. At the beginning of 20th-century clinical labs were established in all USA hospitals. The 20th century also marked the start of a quality revolution in hospitals and laboratories. Hospitals started to reorganize their laboratories and began appointing biochemists. Many regulatory groups marked their beginning in the 20th century to ensure quality lab work.

## 2.2 Required competency by the laboratories

The first formal inspection of laboratory settings was carried out in 1918 by

American College of Surgeons (Issurin, 2010). The aim of this inspection was to check the adequate staffing in the labs. In the 1920s, the clinical laboratory set up had different divisions; biochemistry, immunology, bacteriology, serology, pathology and radiology. The lab offered jobs to trained professionals.

By 1923, 48 percent of U.S. hospitals had clinical laboratories, according to an American Medical Association (AMA) survey, and 14 percent of all U.S. clinical laboratories were private or reference laboratories, according to another survey in 1925. In the year 1934, AMA established the code of ethics and started delegating the healthcare work that was repetitive and time consuming to the laboratory personnel. In 1928 American Society for clinical pathologist (ASCP) established the BOC (Board of certification) as the initial process for technologist certification in the medicinal practice field (Bruce Alexander, 2013).

After the code of ethics established by AMA, physicians established new protocols that would allow them to assign repetitive and time-consuming tests to other certified healthcare aides. Physicians required technical assistants to help them in performing laboratory testing. By 1928, when the ASCP established it's BOC, women constituted 80% of applicants for ASCP medical technologist (MT) certification (Peek et al., 2018). However, even after certification, the lab technologist could work only under physician supervision and the technician was refrained from making written or oral diagnosis.

After 1960, a framework of formal college education was established which was a blend of college course and clinical practice. This formal education gave them a bachelor's degree in medical technology and were trained well to understand the inter relationship between testing and diagnosis and its resulting manifestations. As the role of laboratory technologists became more complex and had significantly changed with

the advancement of healthcare henceforth, the formal courses in health colleges had been revised to prepare graduates for the advancement of technological challenges.

This newly revised programme was designed in education settings with a written mission and stated the purpose and goals to be achieved. The programme clearly stated the activities, policies and allocation of resources. The main core element of these programmes was to provide trained MLTs and MLSc to the clinical settings. The MLT and MLS were qualified by academic courses and clinical practice to be able to provide services to clinical laboratory science and other healthcare fields.

These trained MLTs and MLSc possess a broad scope of understanding of scientific concepts that guide the test and other laboratory-related tasks. This broad scope of knowledge helps technologists and scientists to perform not only various tests in the laboratory settings but they are trained on problem-solving skills, developing new test methods, conducting research, consulting in addition to laboratory management skills. The combined curriculum designed with academic courses and clinical practice helps MLTs to work in all healthcare settings; biotechnology, public health, genetic testing, forensic science, and other scientific fields.

Therefore, MLT/MLS play a major role in providing accurate and timely laboratory results as an estimate states that 70 percent of all patient diagnosis and treatment is based on laboratory test results. (ACLA, 2017). Henceforth, the curriculum is continuously modified. The framework for the MLS and MLT courses should be in accordance with the program's mission (Brown et al., 2015). In addition, the program should be able to satisfy the student's professional needs. The learning methods, teaching, assessments should contribute to the mastery of the content among the students. Henceforth there should be a transformation among students from basic laboratory understanding to achieve complex laboratory skills.

To achieve the goal of providing skilled MLTs, the curriculum should be designed to provide the students with the most relevant, detailed, and updated information. There should be logic and sequence in which courses are taught so that students gradually understand the laboratory requirements. The curriculum of the MLS and MLT programs should be consistent with the program's mission and suitable for meeting the professional needs of students. The ultimate aim is to make students proficient in the field of health, disease detection, and their relationship with the diagnostic field (S. J. Beck & K. Doig, 2002). The students should be skilled and well oriented to understand a disease and the investigations required to reach a diagnosis. This proficiency and skilled technical workforce will analyze the results with the least discrepancies.

*2.3 Clinical internship implementation and its role in training MLT and MLS*

According to (Anderson, 2016), the program designed for MLT and MLS has two basic phases. In the first phase, a student completes foundation courses in the college settings, and then in the second phase, they are trained in the hospital or healthcare laboratory settings through clinical practice. The clinical practice provides students with real-world laboratory experiences and they are trained in three phases of lab work; pre-analytical phase (physician assigning the test to the time sample is received in the lab), analytical phase (processes related to the testing of the specimen in the lab), post-analytical (the process of report writing and delivery of results after quality-check).

To obtain and complete a bachelor's degree for MLTs/MLS, each country has different education criteria. A balanced approach of didactic method and clinical practice should be maintained however, variations are seen in different countries based on practice scopes and legislative discrepancies.

USA - A bachelor's degree in medical laboratory science should be earned to work as MLT /MLS. USA follows a 3+1 programme, 2+2 programme, and 4+1 programme. In the 3+1 program, the students attend courses for 3 years followed by one year of the clinical practice training. In the 2+2 program the students get 2-year courses and 2 years of clinical training. In 4+1 programme the students already completed their undergraduate studies and one-year of clinical practice training is completed at clinical sites.

Australia - A four-year undergraduate degree in medical laboratory science accredited by the Australian Institute of the medical scientist is the requirement (Mortazavi, 2020).

Canada - The MLTs have to finish 3 years of degree, which includes various courses and also includes an internship in two courses. After completion of the degree, they need to be certified by the Canadian Society for Medical Laboratory Sciences (Mortazavi, 2020).

India - In India to be a professional MLT, 3 years and 6 months bachelor's degree is required. In 3 years, various courses are in the curriculum followed by 6 months of hospital training (Turgeon, 2021).

Pakistan - The Pakistan national institute of health offers a four-year bachelor's by the university of health sciences, Lahore (Saaiq, 2020).

Saudi Arabia - The MLT program was established in King Faisal University in the year 1989. This university offers an MLT program with a 2+2 curriculum. During the first 2 years courses are given in the university followed by the practical training program in the final semester (Alyaemni & Qassam, 2017).

Qatar - The medical laboratory science bachelor degree includes; basic courses at a university followed by clinical practice and national certification examination

(Azar, 2020).

At Qatar University, the mission of the Biomedical Science program major is to provide all tools to the students in order to qualify them in clinical and research settings. This program is a 4-years BSc program delivered by the Biomedical Sciences Department (BMS) at the College of Health Sciences (CHS). Five separate clinical practice courses are included in the last 20-week semester, during which the students rotate through the different laboratory parts of Hamad Medical Corporation-related hospitals.

*2.4 The role of NAACLS and other authorized bodies*

The MLS/MLT programs run in different countries aim at providing a range of services required to the healthcare laboratory support system in the most efficient and effective manner. The curriculum requirements for MLT and MLS education have been mentioned in NAACLS standard guideline VIII A as these guidelines are required for accreditation of the course. In addition, the standard guideline mentioned in II B helps in outcome measurement to assure the quality of the MLT curriculum (Scanlan, 2013). These NAACLS curriculum standards and guidelines are followed by all universities running accreditation MLTs programs.

The USA follows the same curriculum as mentioned by NAACLS. It requires the student to acquire basic chemistry, biology, and other foundation science knowledge before starting the MLS program in the USA. Students acquire basic organic and biochemistry knowledge to fulfill the chemistry requirements as this enhances the student's understanding of human biochemical reactions, human genetics, metabolism, and enzyme-catalyzed reactions. This knowledge in the field of chemistry sets a strong foundation for various chemical and biochemical testing. The other coursework includes biology which makes students knowledgeable on human anatomy and

physiology. In addition, the understanding of major organ systems of the body and biochemical principles related to the human body will help students to understand the abnormal body results.

In addition to anatomy and physiology, the study of genetics, immunology, and microbiology is also a part of the coursework. Molecular Biology courses enhance their knowledge related to modern diagnostic biotechnology, DNA probes, genome sequencing, and polymerase chain reaction. Microbiology studies help them to understand the pathogens, handling of pathogens and their isolation in a safe manner. Immunology makes them well orientated on innate and adaptive immunity and antibody titers. This course training gives a solid background for clinical practice. The program also includes basic knowledge related to scientific research which includes good communication skills; written and oral, scientific data interpretation, lab management basic concepts like labor laws, budgeting, staffing, and the ability to orient new staff in the labs.

The courses are followed by clinical practice in which students work with trained professionals in hospitals and clinics. This clinical experience enhances their skills and gives them real-world work experience. The clinical practice aims at making graduates competent at the entry-level of their careers at the entry. In the USA, after finishing the course curriculum and clinical practice the graduate is required to certify the USA by the American Society for Clinical Pathology's Board of Certification (BOC), the American Medical Technologists (AMT), and the American Association of Bio analyst (AAB).

The MLT curriculum should help students to become efficient to work on simple and complex laboratory diagnostic methods. However, the efficiency of students depends upon the quality of education and training received at the respective institutes

and universities. The quality of any work can only be judged if it is compared with some international acceptable standards henceforth, certain governing agencies control the quality of the education globally to provide the most skilled laboratory personnel. These organizations measure the training practice, quality education and regulate certification for laboratory personnel. One of the major international agency, which governs standards in education, training for laboratory professionals, is the National Accreditation Agency for Clinical Laboratory Sciences (NAACLS), and its sponsoring organizations the American Society of Clinical Pathology (ASCP) and the American Society for Clinical Laboratory Science (ACLS).. The mission of all these organizations is to achieve a common goal of quality education in clinical laboratories and improved student's practical knowledge (Primrose, 2019).

NAACLS, established in 1973, is an independent, non-profitable organization and is located in Rosemont, Illinois. During 1973 ASCP was providing accreditation to laboratory programs however, the demand for accreditation increased. Therefore, the US, office of education (USOE) decided to structure a new independent and autonomous body for reviewing the lab accreditation process. The ASCP and ASMT (American society of medical technologists) with mutual efforts created NAACLS in late October 1973.

NAACLS is an internationally accepted standard accreditation body that provides accreditation to organizations that satisfy the NAACLS standards in education. The main role of this organization is to ensure the quality of laboratory work in all accredited organizations. NAACLS provides an accreditation following self-studying process, site visit process, committee evaluation, assessment of review committee, evaluation by the quality assurance committee, evaluation by the board of directors. NAACLS also carries out audits and then as per the reports provided by

NAACLS the CAHEA grants or denies accreditation (Moore, 2019).

The MLTs and MLS after earning a degree from NAACLS accredited college program can apply for globally recognized (ASCP) American society for clinical pathologist certification. ASCP is an organization based in Chicago since 1922 and providing certification to lab technologists worldwide as per their knowledge and competency. The organization aims at providing better education, experience, licensure of certificates which benefits both laboratory professionals and the patients in the healthcare sector (Moore, 2019). Apart from patient care and lab professional's certification, ASCP also provides services to students, lab professionals, even program directors planning to apply for the certification exams.

The ASCP certification is not only a requirement for working as lab technologists but also (PDs) program directors and faculty members are also encouraged to have ASCP certification. The ASCP certification is acquired by faculty members and PDs as its a NAACLS requirement also. According to (Steward & Thompson, 2006), the ASCP Board of Certification (BOC) is the gold standard in global certification for medical laboratory professionals and has certified more than 500,000 individuals. It is the first and largest certification agency since 1928 and has high standards for quality and competency (Aziz & Tille, 2018).

ASCLS (American Society for Clinical Laboratory Science) is another standard organization based in Virginia, established in the year 1933 focuses on applying ethics in laboratory settings, providing quality standards in preventing, diagnosing, management, and prognosis of diseases (Moore, 2019). In addition, ASCLS is a proficient organization that grants clinical laboratory professionals and practitioner advocacy, and continuing professional education.

ASCLS aids Laboratory professionals in developing personally and

professionally by offering numerous opportunities for the members to participate in various activities, events, and meetings. However, most importantly, ASCLS provides numerous and varying continuing education courses that are Professional Acknowledgment for continuing education (P.A.C.E) approved and hence allows its members to gain (CE) Credit hours that are subsequently required to maintain certification and licensure in laboratory professions. Professional Acknowledgment for Continuing Education In addition, Accreditation agencies plan to provide accreditation to universities as well as certification to health practitioners to ensure that they are competent in their jobs knowledge.

*2.5 The support of laboratory clinical training internship*

Gardner and Entry (1990) found in their 10 years study period from 1983 to 1993 that showed that Laboratory job duties are transitioning to higher-level technical jobs. They also discovered that management-related practices such as marketing, budgeting, quality assurance, and documentation had been added to laboratory jobs (S. J. Beck & K. Doig, 2002). Almost 80 tasks related to laboratory management were identified in National Credentialing Agency for Laboratory Personnel (NCA) work analyses conducted in 1998-99.

These activities will be carried out by highly trained lab staff, who after completing degree programs must have talents, skills, and experience related to their particular employment. They should be self-assured and capable of taking action in the workplace that leads to a good result. These are referred to as entry-level competencies. These entry-level skills are a blend of academic expertise and practical experience gained through various courses and clinical training. They should be able to conduct clinical laboratory research in immunology, microbiology, urine and fluid analysis, hematology, clinical chemistry, and lab operations. Additionally, laboratory technicians

should also have professional behavior skills, good communication skills, safety and regulatory law knowledge, lab management, and clinical laboratory design knowledge (Hughes, 2020). These all competencies together make employees efficient at work (Valdez, 2010).

MLTs must have high entry-level competencies due to the changing work environment in laboratories. Educators, practitioners, and managers all agreed that lab staff is now doing the majority of laboratory testing and that in the future, they will be doing less testing and more problem-solving (S. J. Beck & K. Doig, 2002). The accredited program should include concepts of critical pathways, clinical decision making, performance improvement, and dynamics, according to the NAACLS Standards. Students must also be well-versed in management activities as well as technological issues in order to meet entry-level competencies and accreditation requirements (Scanlan, 2013).

A well-constructed assessment plan is required to evaluate the entry-level competencies as well as the course assessment. Due to the rising demand for trained laboratory specialists in the healthcare sector and the advancement of technology, these evaluation plans are becoming increasingly relevant in today's universities. These evaluations provide information about the effectiveness of the curriculum and training offered in the programs.

To understand the effect of the curriculum, a well-developed evaluation plan includes both qualitative and quantitative data. Certain methods have been created as a result of the increased importance of evaluating curriculum learning outcomes and entry-level competencies in higher education. The evaluation matrix is the most useful method for assessing the result.((NAACLS), 2020) It consists of direct methods such as an essay, quantitative tests, presentations, assignments, curriculum chart, grading

system, and indirect methods such as surveys, interviews group discussions that reflects students learning and competencies.

According to (Aziz & Tille, 2018), Presentations, assignments, and essays are examples of classroom evaluation tools that can be used to evaluate a student's attitude toward learning. This approach to use direct tool assessmnet for mapping entry level competencies and skills of gradutes is a continuous process aimed at achieving the program's objectives. To measure the success of the program the indirect tools (surveys, group discussions and interviews ) are also added to the assessment plan. These indirect tools are very time-consuming however; indirect tools can help in understanding the success of the program and the entry-level competencies from the student's point of view.

The student's opinion is of high importance as they are themselves going through the process of training and can depict the drawbacks. A survey conducted by the Association of American colleges and universities (AACU) has shown the graduates are well prepared in their own eyes however, the employers are concerned about their skills and entry-level competencies (Gergerich, Boland, & Scott, 2019). These differences in opinions of students and employers clearly show that there is a discrepancy in learning and applying skills.

It becomes more important to understand student's perspective so that discrepancies in skills gained and derived can be modified. In biomedical graduates, its further more required as they are going to work as skilled personnel in healthcare. Their entry-level competencies depend on a lot on their knowledge, application of skills gained during clinical training. In an attempt to explore the student's perspective on skills gained and derived and their satisfaction rate related to content and clinical courses this study has been executed.

# CHAPTER 3: METHODOLOGY

*3.1 Study population*

      This cross-sectional study includes BMS Biomedical science graduates, who successfully completed their clinical practicum as part of their undergraduate study in Qatar between spring 2015 and fall 2019. The data of BMS graduates was obtained from the alumni database maintained by the CHS students' affairs. The database included 167 graduates and out of which 130 graduates were enrolled for the study.

*3.2 Ethical Consideration and Approval:*

      The study survey was approved by Qatar University-Institutional Review Board (QU-IRB) and Ethical approval was obtained under QU-IRB1360-EA/20 (Appendix A.). The study was based on the voluntary participation of the graduates. A consent form was prepared (Appendix B.) and was sent as a google doc to the cohort (2015-2020) via provided contact number in the alumni database.

      The consent form obtained from graduates included the aim, procedures and benefits involved in the study. Study participants confidentiality was maintained by not disclosing the name, identity or opinions of the study subjects. In addition, participation was voluntary and they were free to withdraw from study at any given time. After the consent was obtained voluntary, the participant was interviewed over the telephone.

*3.3 Inclusion and Exclusion Criteria*

      Graduates from BMS, since last 5 years (2015-2020) were only included in the study. Graduates refusing to participate were excluded from the study. In addition the students with incorrect contact details and those who were unemployed during the survey were also excluded.

*3.4 Research Instrument*

      This cross-sectional survey tool used is a student feedback questionnaire (Appendix C.) for assessing the graduate perspective on clinical practice. The research

tool was adapted based on an extensive literature review of NAACLS and ASCLS ((NAACLS), 2020; ASCLS, 2018; S. J. Beck & K. Doig, 2002; Camillo, 2019; Gurjeet Singh, 2019; Scanlan, 2013), consultation with experts in the field of MLS clinical teaching, and the existing practice of MLS accredited program at Qatar University since 2007. The entry-level competencies and skills required in workplaces were aligned to multiple competencies described by the ASCLS, and the ASCP Board of Schools (ASCLS, 2018; S. J. Beck & K. Doig, 2002; Joan Polancic, 2016). These entry-level competencies were re-classified to reflect the three domains of learning: cognitive, psychomotor, and affective.

*3.5 Data Collection*

BMS graduates were contacted through telephone interviews to collect data such as their employability status; and work placement. Five-level Likert scale of bipolar response "Strongly disagree" "disagree" "neutral/undecided" "agree" "Strongly agree" was used to rate the graduates satisfaction toward the clinical training internship content, and clinical instructors who mastering it (Pimentel, 2010). The content part of the telephone interview includes satisfaction on organization structure, materials, evaluation criteria and length of content. The questions related to clinical instructors include instructors attitude towards teaching, knowledge and expertise in teaching.

A unipolar scale "Not at all " "little" "to some extent" "well" "very well" was used to rate the wellness of the clinical training internship to develop the MLS entry level competencies of graduates as per the cognitive, psychomotor and affective domains of learning (DeCastellarnau, 2018). The former scale was also used to rate the extent of utilizing these skills at the graduates' profession. The telephone interview ends with an open question about opportunity to improve the program (Appendix C).

It has been decided to use the study tool as a telephone interview due to COVID-19 pandemic and the safe precautionary measures practiced in the state of Qatar. Telephonic interview was conducted with each BMS graduate for 15- 20 minutes. The telephone interviews were administered to all participants in English. No audio recording was done due to social and cultural restrictions. Data was collected over two months period (December, 2020–January, 2021). It was entered into Excel sheet and imported to Statistical Package for Social Sciences (SPSS Chicago IL, USA, version 26) for statistical analysis.

*3.6 Statistical Analysis*

The statistical analysis includes descriptive analysis and non-parametric tests. The descriptive analysis has been used to obtain accurate information related to attributes of content, clinical instructors, skills derived during clinical training, and later skills applied at the workplace. The skills were studied in three domains; Cognitive domain, psychomotor domain, and Affective domain.

In addition, non-parametric tests; Wilcoxon test, and Mann Whitney tests were performed to analyze the relationship between variables. These tests were used to compare the variables, as they are not normally distributed.

To compare variables; skills derived and used among each domain, the Wilcoxon test has been applied. Mann-Whitney test was used to compare two independent categories, skills domain and job title categories. The skills domain include; Cognitive skills used, Psychomotor skills used and Affective skills used in the workplace. The job title category includes; Diagnostic Lab professionals and Non-diagnostic Lab Professionals.

CHAPTER 4: RESULTS

A total of 167 graduates' details were retrieved from graduate office, Qatar University. This included all the graduates passed from Biomedical Sciences College from 2015-2020. 130 graduates were interviewed after obtaining voluntary consent. Fifteen graduates were unemployed hence were excluded from the analysis therefore only 115 subjects included in our study.

The graduates were grouped based on their job title into two groups; group 1and group 2.Group 1 included students employed in diagnostic labs and group 2 included graduates working in non-diagnostic labs. 48.7% graduates in the study cohort were working in diagnostic labs as laboratory technologists. The other group of 51.3% graduates were working in non-diagnostic labs as research assistants, research specialist, safety officers.

*4.1    Descriptive Analysis*

*Content*

The descriptive analysis for content of clinical training included four variables. The students answered questions related to organization, content, evaluation criteria and the length of clinical training. The satisfaction rate among graduates for content of clinical training is shown in Table 1.

**Table 1.** Satisfaction Rate of Graduates Related to Content of Clinical Practice

| ANSWERS | Organization N (%) | Content N (%) | Evaluation criteria N (%) | Length N (%) |
|---|---|---|---|---|
| Very unsatisfied | 1(0.9%) | 1(0.9%) | 1(0.9%) | - |
| Unsatisfied | - | 4 (3.5%) | 9 (7.8%) | 18 (15.7%) |
| Neutral/Undecided | 10 (8.7%) | 18 (15.7%) | 24(20.9%) | 14 (12.2%) |
| Satisfied | 62 (53.9%) | 65(56.5%) | 53(46.1%) | 53 (46.1%) |
| Very Satisfied | 42 (36.5%) | 27(23.5%) | 28(24.3%) | 30(26.1%) |

More than 80 % graduates were satisfied with the organization and content of clinical training. A 70 % satisfaction rate was found in terms of evaluation criteria and the length of clinical training as shown in figure 1.
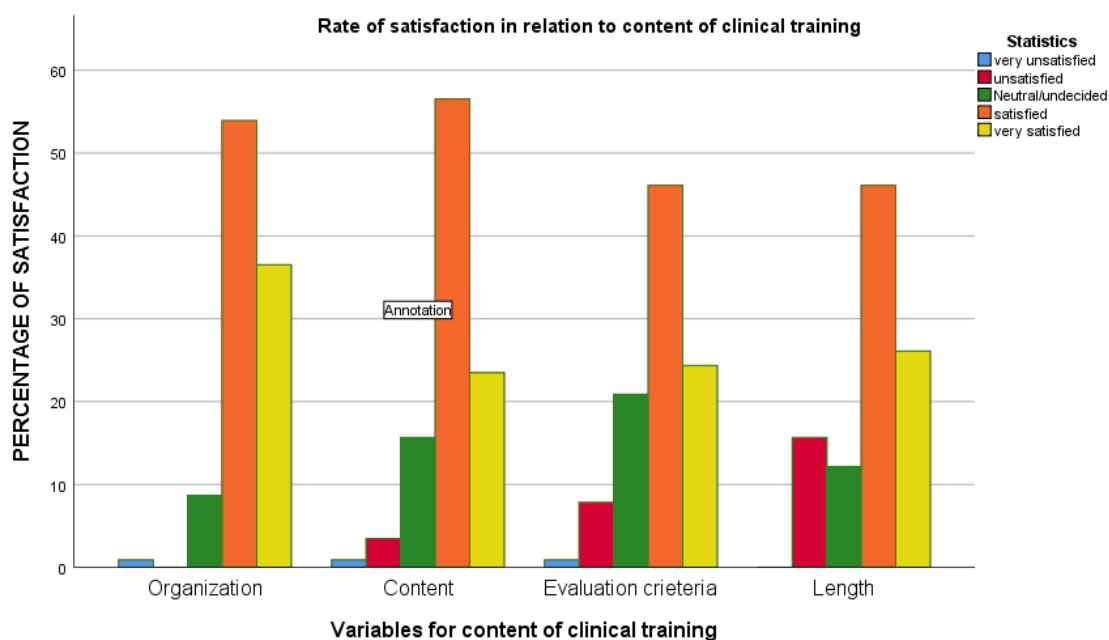


**Figure 1.** Rate of satisfaction in relation to content of clinical training

*Clinical Instructors (Preceptors)*

The graduates gave their opinion related to the clinical instructors during training. They expressed a good satisfaction rate in terms of the attitude of the clinical instructors, command of knowledge, ability to convey knowledge, and their interest in teaching. The satisfaction rate was 53% in term of attitude of the clinical instructors towards students. However, 2.6% students were not satisfied with the attitude of clinical instructor's. A minimal of 3.5% expressed that the instructors were not interested in teaching .On the contrary,53% expressed that clinical instructors were devoted towards teaching as shown in table 2 and figure 2.

**Table 2.** Satisfaction Rate of Graduates Related to Clinical Instructors during Clinical Practice

| Answers | Instructor attitude N (%) | Command N (%) | Knowledge and expertise N (%) | Interest in teaching N (%) |
|---|---|---|---|---|
| Very unsatisfied | - | - | - | 1 (0.9%) |
| Unsatisfied | 3 (2.6%) | - | 1(0.9%) | 4 (3.5%) |
| Neutral/Undecided | 21 (18.3%) | 18 (15.7%) | 20 (17.4%) | 30 (26.1%) |
| Satisfied | 61 (53.0%) | 66 (57.4%) | 70 (60.9%) | 61 (53.0%) |
| Very Satisfied | 30 (26.1%) | 31 (27.0%) | 24 (20.9%) | 19 (16.5%) |
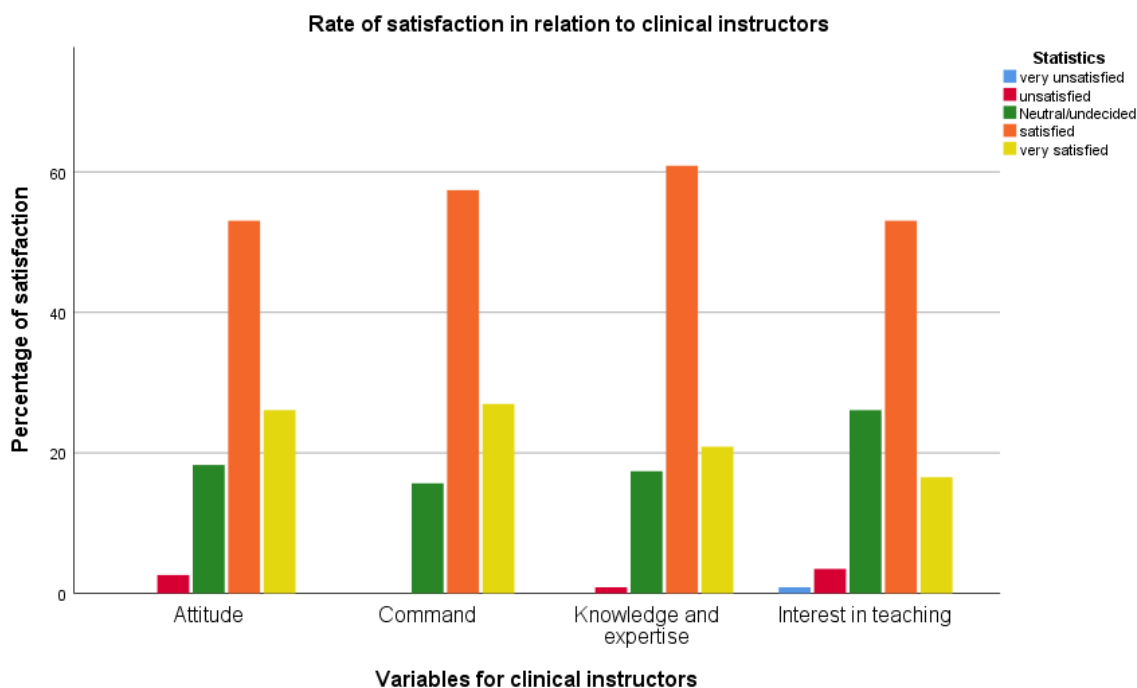
**Figure 2.** Rate of satisfaction in relation to clinical Instructors

*Cognitive Domain descriptive analysis*

A descriptive analysis of the cognitive domain was applied and the participants in this study answered six questions related to variables; Recalling, organization, lab management; budgeting and staffing, interpretation of results, critical analysis, and ability to retrieve from sources as mentioned in the table 3.

**Table 3.** Cognitive Domain Variables(Adapted from NAACLS )

| Cognitive Domain Variables |
| --- |
| Recall basic knowledge and skills |
| Organization structure, management, safety, infectious control measures, quality management |
| Financial management, budget, staffing HR Laws |
| "Interpretation of content /results" |
| "Critical analysis and problem-solving skills" |
| Ability to retrieve information from range of sources |

The variables studied and their descriptive analysis is mentioned in table 4.

**Table 4.** Cognitive Domain (Percentages of Skills Derived /Used)

| Scale | Recalling | | Safety and quality control | | Lab management | | Interpretation | | Critical analysis | | Ability to retrieve | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D % | U % | D % | U % | D % | U % | D % | U % | D % | U % | D % | U % |
| 0 | - | 7.8 | - | 3.5 | 49.6 | 40.0 | 1.7 | 16.5 | 11.3 | 17.4 | 8.7 | 13.9 |
| 1 | 0.9 | 8.7 | 3.5 | 3.5 | 17.4 | 3.5 | 6.1 | 3.5 | 4.3 | - | 4.3 | 1.7 |
| 2 | 18.3 | 22 | 13.9 | 7.8 | 16.5 | 10.4 | 27.8 | 12.2 | 28.7 | 8.7 | 4.3 | 1.7 |
| 3 | 41.7 | 40.9 | 28.7 | 26.1 | 14.8 | 32.2 | 36.5 | 27 | 41.7 | 38.3 | 40 | 36.5 |
| 4 | 39.1 | 22.6 | 53.9 | - | 1.7 | 13.9 | 27.8 | 40.9 | 13.9 | 35.7 | 21.7 | 38.3 |

The descriptive analysis on six variables has been explained below:

*Recall basic knowledge and skills:* The descriptive analysis showed that 41.7 % of graduates were well trained in recalling basic information skills. 39.1 % of research subjects knew this skill very well. 18.3 % learned it to some extent and only 0.9 % had very little of this skill. 40.9 % of graduates applied basic information well. This skill was very well applied by 22.6 % of subjects. 20% used this skill to some extent and only 8.7% used the ability to a limited extent.

*Organization structure, management, safety, infectious control measures, quality management*: During clinical practice, 28.7 % derived the skill well. 53.9 % had very good knowledge of this skill, but they never applied or used this skill in their work placement. 13.9 % graduates learned this skill to some extent and only 7.8 % out of these this skill in their career .In addition,3.5 % even said they never learned or used this skill.

*Financial management, budget, staffing, HR Laws:* This skill was the one in the cognitive domain that was least developed or used by graduates. During clinical

practice, 49.6 % never gained any knowledge about lab management and budgeting. 17.4 % graduates acquired little of this ability and out of these only 3.5% students applied in their respective workplaces.

To some extent, this ability was discovered among 16.5% and later only 10.4% was its application in their employment. Furthermore, 14.8% reported to have learned the expertise of laboratory management well and to an extent of 32.2%, they also used it well in their jobs. Only 1.7% mastered and learned this ability very well.

*Interpretation of content /results:* During clinical practice, 36.5% and 27.8% of graduates could interpret the outcomes well and very well respectively. These graduates used the ability to interpret the results well 27% and very well 49.0% in their jobs.27.8% could only interpret results to some extent during clinical practice and later application in their jobs was only 12.2%. There were 1.7% of students who, during clinical practice, never learned this skill.

*Critical analysis and problem-solving skills:* At hospital training, 41.7 % of graduates claimed to improve their problem-solving skills and later used them well to 38.3 %. Only 13.9 % graduated with this ability very well and they later used problem-solving skills extensively to 35.7 % in their career. 4.3 % had this ability little and 11.3 % never acquired this skill during their training.

*Ability to retrieve information from a range of sources:* The ability to retrieve data from various sources was extracted well and very well by 40% and 21.7% graduates respectively and implementation was also found to be strong. However, to some degree, 25.2 % were aware of this ability but application later in their jobs was only 9.6 %. A very little ability to retrieve data from a variety of sources was found in a minimum of 4.3 %.

The data illustrated that graduates were proficient in the skills related to safety

management, working on infectious materials and recalling basic knowledge and skills as shown in figure 3.
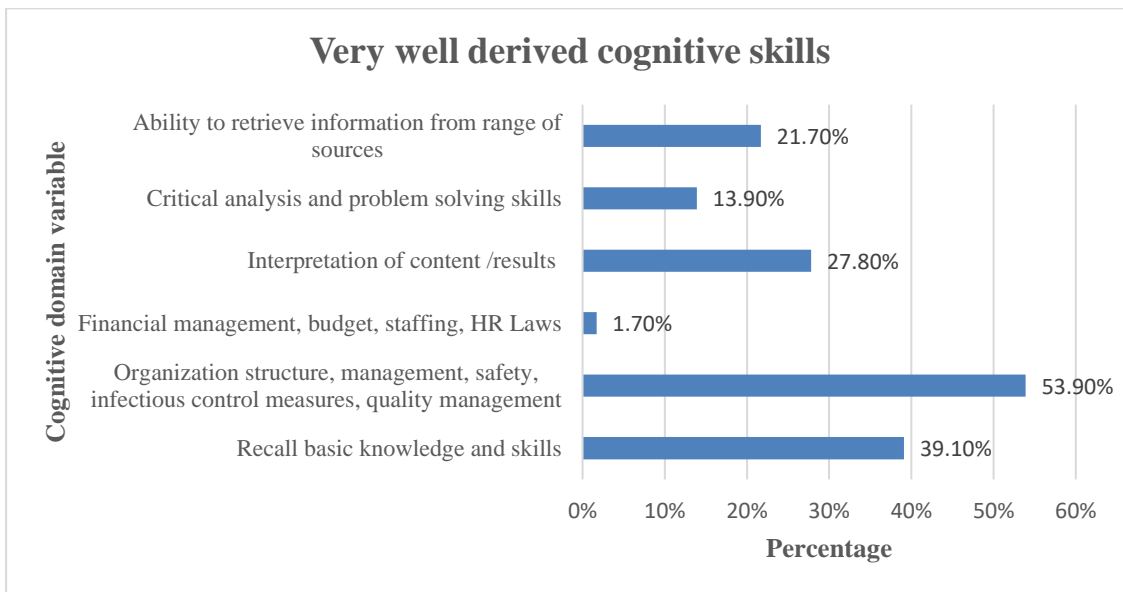


**Figure 3.** Very well derived cognitive skills

However, few skills that were never gained by students as shown in figure 4 skills related to financial management, budgeting were not gained by the 49.6% of students during training. The second least derived skill is critical thinking and problem-solving.
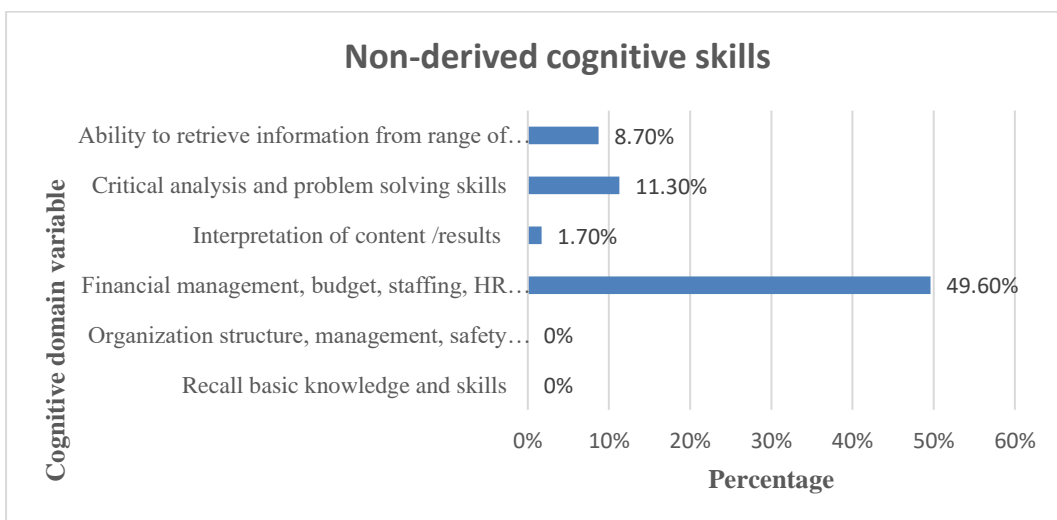


**Figure 4.** Non-derived cognitive skills

*Psychomotor Domain descriptive analysis*

A descriptive analysis on psychomotor domain was applied and seven questions were asked from participants in this study. The variables related to psychomotor Domain are mentioned in table 5.

**Table 5.** Psychomotor Domain Variables (Adapted from NAACLS )

| **Psychomotor Domain Variables** |
| --- |
| Readiness; an awareness of and ready to analyze samples or observe |
| Competence and confidence with performing a task or analyzing samples |
| "Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations" |
| "Research skills (e.g., planning and design experiments)? |
| Information and communication technology skills |
| "Report writing and written communication skills" |
| "Oral presentation and verbal communication" |

The variables studied and their descriptive analysis is in table details are mentioned below:

**Table 6.** Psychomotor Domain (Percentages of Skills Derived /Used)

| scale | Readiness | | Competence | | Proficiency | | Research skills | | IT skills | | Writing skills | | Oral skills | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | D | U | D | U | D | U | D | U | D | U | D | U | D | U |
| | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| 0 | 1.7 | 13.95 | - | 6.1 | 13 | 16.5 | 22.6 | 28.7 | 15.7 | 20 | 19.1 | 25.2 | 19.1 | 24.3 |
| 1 | 10.4 | 4.3 | 6.1 | 4.3 | 8.7 | 0.9 | 2.6 | 0.9 | 4.3 | 0.9 | 2.6 | - | 2.6 | - |
| 2 | 30.4 | 18.3 | 30.4 | 12.2 | 37.4 | 16.5 | 32.2 | 13 | 20.9 | 10.4 | 22.6 | 7 | 20.9 | 6.1 |
| 3 | 36.5 | 20.9 | 33.9 | 23.5 | 27 | 27 | 23.5 | 22.6 | 26.1 | 19.1 | 32.2 | 22.6 | 34.8 | 27.8 |
| 4 | 20.9 | 42.6 | 29.6 | 53.9 | 13.9 | 39.1 | 16.5 | 34.8 | 33.1 | 49.6 | 23.5 | 45.2 | 22.6 | 41.7 |

*Readiness; an awareness of and ready to analyze samples or observe:* The skill related to Awareness of the samples to be analyzed was derived well by 36.5% of

27

students and around 20.9% derived it very well. The skill derived very well was also implemented equally well by 42.6 % of graduates. That 30.4% of participants who acquired this skill to some extent used it up to 18.3 % in their field.

*Competence and confidence with performing a task or analyzing samples:* Competence and confidence to perform a task was gained well by 33.9%individuals and applied well by 23.5% of participants. That 29.6% who were confident to perform a task also used extensively up to 53.9% in their jobs. Graduates gaining the skill up to 6.1 % used it in the workplace also very little up to 4.3 % only.

*Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations:* The ability to adapt and perform well in unexpected situations was well learned by 27.0 % and also implemented equally well. Those who acquired it only 13.9 % used it better in their work up to 39.1 %. Competency and working in new situations were to some extent adopted by 37.4 %t graduates. However, 15% of graduates never acquired the ability to perform in new situations.

*Research skills (e.g., planning and design experiments):* A total of 23.5 % of students derived well the skills related to research planning and designing and used them by 22.6 % in their work. On the contrary, 22.6 % of graduates said they never learned any kind of research skills during clinical practice. That 16.5% who mastered the skill also proficiently used it in professional areas up to 34.8 %. Those with some extent of knowledge on research skills were 32.2 % and just 13.0 % was applied to the workplace.

*Information and communication technology skills:* The ability was acquired very well by 33.1% and used also very well by 49.6 % of students. To some extent, 20.9 % of graduates acquired the skill, and 10.4 % applied communication skills at

work. However, 15.7 % never gained this ability from clinical practice and 4.3 % gained very little of this ability.

*Report writing and written communication skills:* Report writing skills were enhanced well by 32.2% and very well by 23.5% of students. The usage of the skill was also extensively applied by 45.2% at their jobs. To some extent skill of report writing was adapted by 22.6% but they used it very minimal to 7.0% only.

*Oral presentation and verbal communication*: Oral presentation and skills related to verbal communication were enhanced by 34.8% of students, on the contrary,19.1 % of graduates never learned this skill from clinical practice training. Among those 2.6% who gained skill to some extent never applied it in their jobs. Efficiency to some extent in the oral presentation was reported by 20.9% but only 6.1% of this efficiency was reported to be applied at their jobs. The students who derived the skill very well were 22.6% and later these graduates applied the skill extensively up to 41.7%.

The analysis described that graduates achieved the capacity associated with information and communication technology very well. The second highest driven skill was related to their competence and confidence to perform a task that was learnt very well by 29.6% graduates as mentioned in figure 5.
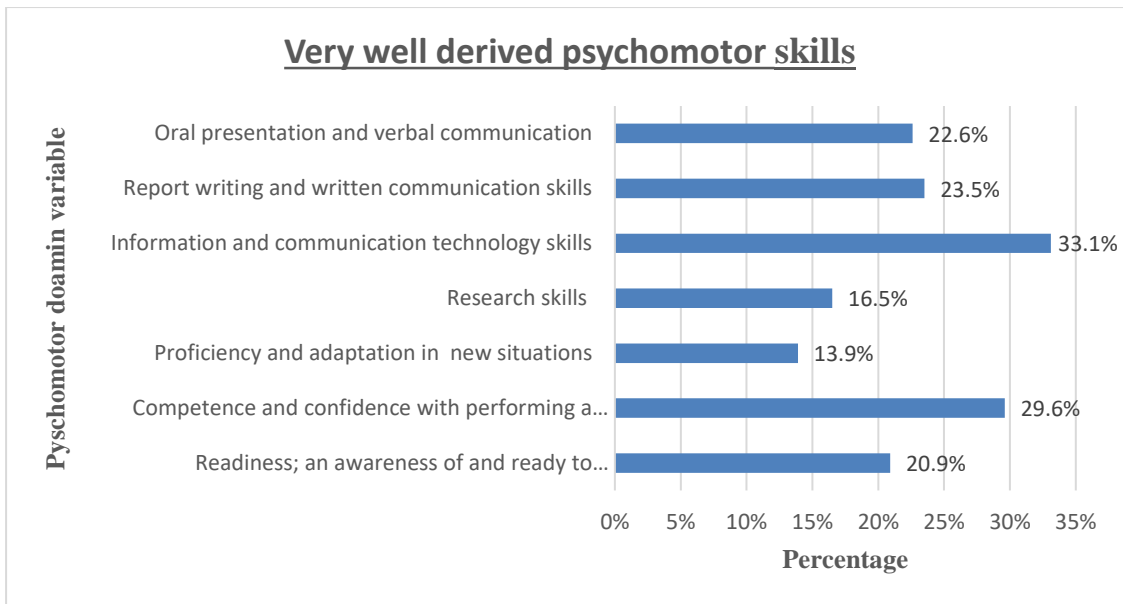
**Figure 5.** Very well derived psychomotor skills

The analysis found that in psychomotor domain the skill related to Research ; planning and designing experiments was least developed and in addition oral presentation and report writing skills were not learned by 19.1 % graduates as mentioned in figure 6.
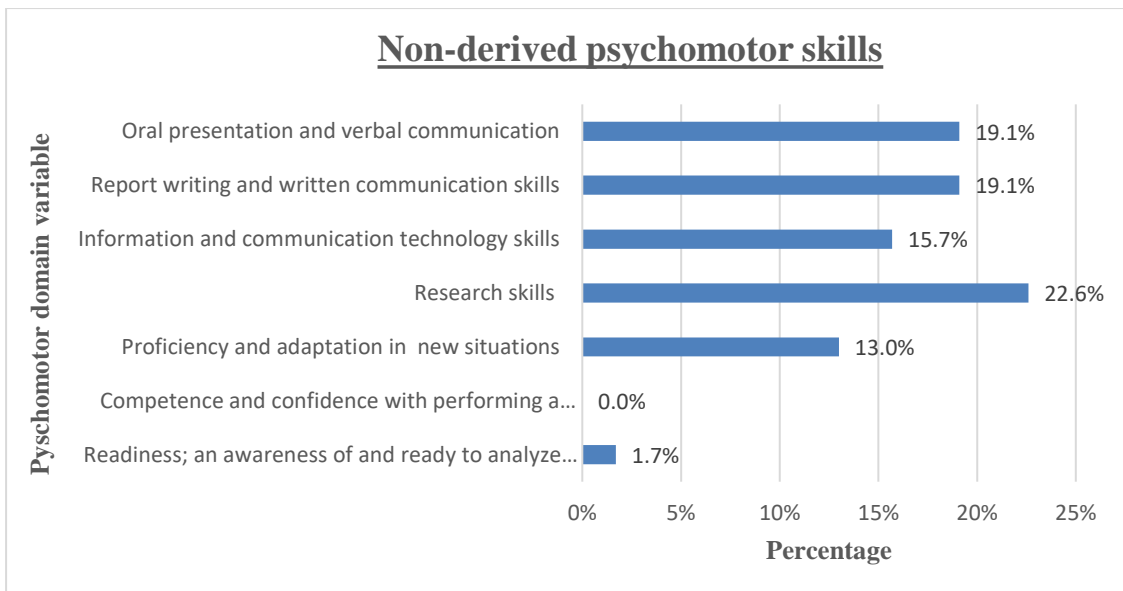


**Figure 6.** Non-derived psychomotor skills

*Affective Skills Descriptive Analysis*

A descriptive analysis on the affective domain was applied and participants in this study answered six questions. The cognitive domain variables and descriptive analysis is shown in the table 7 and table 8 respectively.

**Table 7.** Affective Domain Variables (Adapted from NAACLS )

| **Affective Domain Variables** |
| --- |
| Appreciation of ethical scientific behavior |
| "Leadership skills" |
| "Team working skills" |
| "Time management & organizational skills" |
| "Ability to use own initiative" |
| "Ability of independent learning for CPD" |

**Table 8.** Affective Domain (Percentages of Skills Derived /Used)

| Scale | Ethical behavior | | "Leadership skills" | | Team working skills | | "Time management and organizational skills" | | Taking own initiatives | | Independent learning | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **D** | **U** | **D** | **U** | **D** | **U** | **D** | **U** | **D** | **U** | **D** | **U** |
| | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** | **%** |
| 0 | 7 | 10.4 | 8 | 9.6 | 6.1 | 7.8 | 4.3 | 7.8 | 4.3 | 4.3 | 7.8 | 9.6 |
| 1 | 0.9 | - | 4.3 | 2.6 | 2.6 | 1.7 | 6.1 | 1.7 | 5.2 | 2.6 | 1.7 | 1.7 |
| 2 | 10.4 | 4.3 | 30.4 | 13.9 | 16.5 | 8.7 | 25.2 | 11.3 | 29.6 | 12.2 | 20.9 | 12.2 |
| 3 | 32.2 | 16.5 | 31.3 | 27.8 | 34.8 | 17.4 | 33.9 | 27.0 | 33.0 | 32.2 | 40.9 | 23.5 |
| 4 | 49.6 | 68.7 | 26.1 | 46.1 | 40.0 | 64.3 | 30.4 | 52.2 | 27.8 | 48.7 | 28.7 | 53.0 |

The results of descriptive analysis for affective domain are below:

*Appreciation of ethical scientific behavior:* Among 49.6% of students, the skill was very developed and only 12% appeared to acquire it to some degree. However, during clinical practice, a minimum of 7% never acquired this skill.

*Leadership skills:* The skill to be a good leader was attained very well by 26.1% of students and applied even more in their profession to an extent of 46.1%. Those who gained the skill of being a good leader to some extent were around 30.4% and they used it very little in their profession. There was a small percentage of 7.8% of students who never derived this skill from clinical practice training.

*Team working skills:* The learning to be part of a team and work collectively was very well learned by 40% of graduates and furthermore, this skill was used very well in their profession up to 64.3%. The skill to do teamwork was enhanced to some extent by 16.5% of graduates. At least little knowledge of team working was driven by 2.6% of students.

*Time management and organizational skills:* The skill to manage time and organize things were learned well and very well by 33.9% and 30.9% of students respectively. Those who learn the skill very well also applied to an extent of 52.2% at their workplaces.

*Ability to use own initiative:* A total of 33.0% were able to take their own initiatives during clinical practice and they applied it well in their professions later. The percentage of students not able to take their own initiatives during training as well at the workplace were 4.3%

*Ability of independent learning for continuing professional development:* The skill to attain independent learning was derived well by 40.9% of students. This skill

was applied very well later in jobs also. The students claimed to have this skill minimal up to 1.7% and they also used it very little in their jobs.

The affective skill of ethical scientific behavior was very well learned by the graduates. They learned to do teamwork very well. The abilities related to time management, leadership, taking own initiatives, and independent learning were also very well learned by more than 25% of the graduates mentioned in figure 7.



**Figure 7.** Very well derived affective skills

On the contrary, only 4.3% never developed or learned the ability to manage time and take their own initiatives. The other affective-related abilities were claimed to have not been derived by less than 8% of the trainees shown in figure 8.
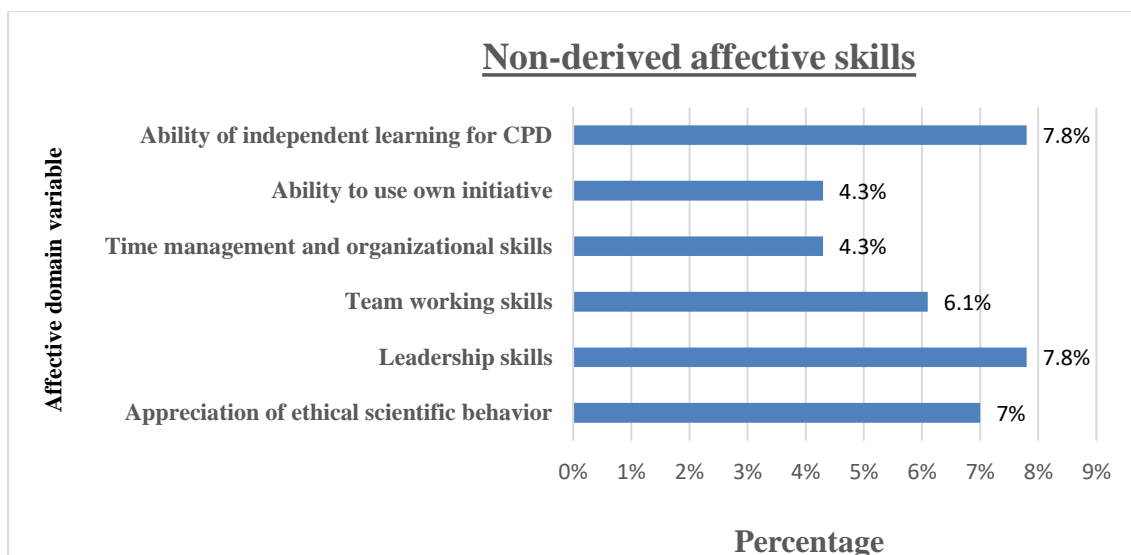
**Figure 8.** Non-derived affective skills

*4.2 Normality test*

The normality testing on all the variables related to skills used and derived was conducted. It was found that none of the variables were normally distributed. The histograms for these variables were skewed towards the left. The mean, median, IQR and Standard deviation are shown in table 9 and figure 9

**Table 9.** Normality Test Results

| Variables | Mean | Median | Standard deviation | IQR (interquartile range) |
|---|---|---|---|---|
| Cognitive skill derived | 8.5 | 9 | 2.4 | 3 |
| Cognitive skill used | 8.9 | 10 | 3.5 | 5 |
| Psychomotor skill derived | 9.4 | 10 | 3.9 | 6 |
| Psychomotor skill used | 10.2 | 13 | 4.8 | 8 |
| Affective skill derived | 10.7 | 10 | 3.3 | 4 |
| Affective skill used | 10.7 | 12 | 3.0 | 2 |
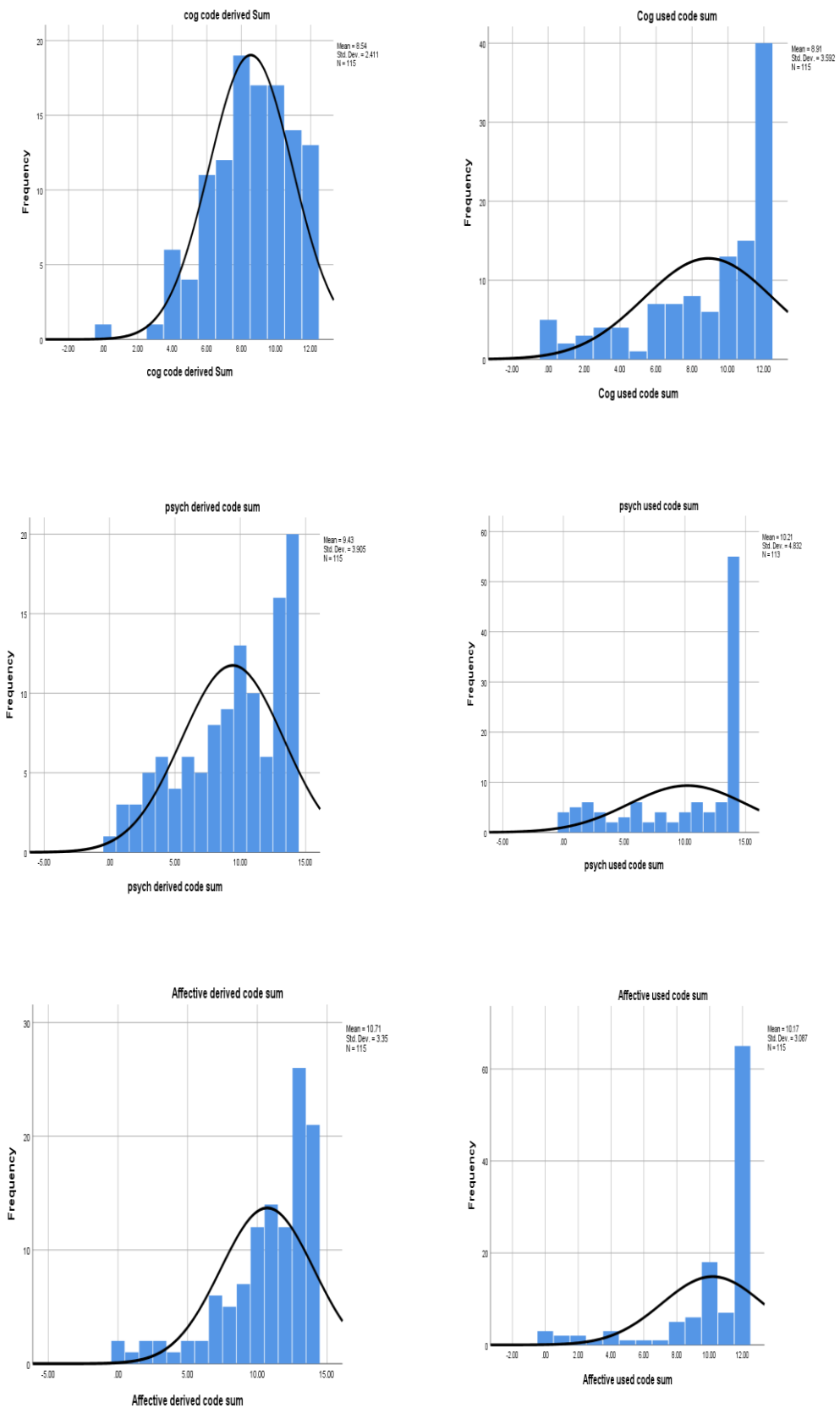
**Figure 9.** Normality test results

*4.3 Non- parametric test (Wilcoxon test):*

The Wilcoxon test was done to compare the skills derived and used for each domain and results are shown in table 10.

**Table 10.** Wilcoxon test results

| Skills derived Vs Used | P value | Results |
|---|---|---|
| Cognitive skills | P>0.05 | Cognitive skills were equally well derived and used. |
| Psychomotor skills | P< 0.05 | Discrepancy in psychomotor skills derived and used. |
| Affective skills | P< 0.05 | Discrepancy in affective skills used and derived |

*Cognitive Skills Derived and Cognitive Skills Used*

There is no substantial difference between this skill derived and used at workplace which is furthermore supported by the Wilcoxon test with a non-significant p value of 0.113 (greater than 0.05). Henceforth the cognitive skills were equally well derived and used.

*Psychomotor Skills Derived and Psychomotor Skills Used*

The correlation between the psychomotor skill derived and used by the Wilcoxon test showed that the p value 0.000 (less than 0 .05) was significant. Thus, there is a discrepancy between psychomotor skills derived and used at the respective jobs.

*Affective Skills Derived and Affective Skills Used*

As the p value is 0.000, which is statically significant supported by the Wilcoxon test henceforth there exists a difference between learning and applying skills in the affective domain.

*4.4 Non-parametric test (Mann Whitney test):*

It was applied to compare the job title with the skills applied at the respective jobs and results are shown in table 11.

**Table 11.** Mann Whitney test results

| Skills used Vs job title | Median value for group-1 (Diagnostic lab professionals) | Median value for group-2 (Non-diagnostic lab professionals) | P values | Results |
|---|---|---|---|---|
| COGNITIVE SKILLS | 11 | 9 | P< 0.003 | Group-1using cognitive skills more than group 2 |
| PSYCHOMOTOR SKILLS | 14 | 11 | P< 0.01 | Group-1using Psychomotor skills more than group 2 |
| AFFECTIVE SKILLS | 12 | 11 | P< 0.016 | Group-1using Affective skills more than group 2 |

*Cognitive skill used as per the job role*

The Mann Whitney test performed showed a median of 11 for group 1 for the use of cognitive skills and a median of 9 for group 2 using cognitive skills. The significant p value of 0.003, statistically supported that in the given cohort Group 1 graduates working in laboratory diagnostic settings using cognitive skills more than group 2 graduates working in non-diagnostic laboratory settings.

*Psychomotor skill used as per job role*

A comparison of the job title groups in using psychomotor skills showed a median of 14 in group 1 graduates and group 2 had a median 11. There were substantial

discrepancies between group 1 and group 2 medians. This was validated statistically by the Mann Whitney test with a P value of 0.010. Group 1 applied the psychomotor skills more in workplace.

*Affective skills used as per job role*

The affective skills were not distributed evenly between two Mann Whitney test groups, giving a significant p value of 0.016. The median for group 1 was 12 and for group 2 it was 11. This significant difference confirmed by statistics concluded that group 1 graduates used affective skills higher.

CHAPTER 5: DISCUSSION

The NAACLS requires the graduates to have entry level competencies to perform all lab related tasks as well as lab operation responsibilities ((NAACLS), 2020)and it was satisfying that students were using skills related to cognitive and psychomotor skills proficiently however the lab operation skills were not derived well by the graduates. A high satisfaction rate in terms of content of Clinical training defined that skills required during pre-analytical, analytical and post-analytical phase were well addressed during clinical training which an additional requirement by the NAACLS. The descriptive analysis showed that students were satisfied with the content of clinical practice. The responses given by graduates for content included; clinical practice organization, materials i.e., samples provided during clinical practice, assessment criteria, and duration of rotations at each laboratory. Overall, graduates were satisfied with the four content attributes; organization, content, evaluation criteria, and length of time allocated for training. As per the training task analysis done by Patrick (Patrick, Gregov, & Halliday, 2000) the students were satisfied with the organization of the clinical training and 90.4% claimed that the objectives of the training were clear to them.

In total, 80% of graduates reported being very satisfied and with the content of clinical practice; students were satisfied with the materials (samples) and instructions to understand and utilize the procedures. The satisfactory rate of students on evaluation criteria related to exams and assignments was 70.4%. It showed students found evaluating methods and grading systems to be fair. In terms of time allocated for different laboratory rotations, the students were satisfied and accepted that it was appropriate and time was well utilized. As per Schmidt (S. W. Schmidt, 2007)the satisfaction related to content and time spent during training is an important parameter

defining success of training .This satisfaction in terms of content furthermore supported success in designing the clinical practice.

The results of the study revealed the level of satisfaction with different aspects of clinical instructors. During clinical practice, there was positive feedback on all aspects of teaching hence reflected the high quality clinical training provided to the student's (Luhanga, Billay, Grundy, Myrick, & Yonge, 2010; Luhanga, Dickieson, & Mossey, 2010). A satisfaction rate of 80% was reported by students in relation to clinical instructor's competence, ability to articulate knowledge, and interest in teaching .Our study indicated that the graduates were fully satisfied with clinical instructors during training which helped them to enhance their skills. Another similar study was done in Los Angeles USA (Keitz et al., 2019) related to the health care trainees' perception skills, teaching capacity, teaching consistency, and approachability also states that clinical instructors interactions with students have a significant impact on student learning. Another similar study on nursing staff educators demonstrated that efficient trainers lead to better professional development.(Smith, McAllister, & Crawford, 2001)(Foy & Waltho 1989)

The second objective of the study was to understand whether the skills learned during clinical practice are also well implemented in their work. To reveal the gaps in the skills obtained and skills applied is the main characteristic of the study as it directly relates to the graduates' entry-level competencies. In the research, the skills relevant to the three domains (Cognitive, Psychomotor, and Affective) were analyzed. These skills are very important for successful job performance. Although, the survey found that overall the skills in three domains were derived well and also applied well at workplaces by graduates, however, our findings indicates room for improvement in all domains.

Our results related to cognitive abilities showed no substantial difference between the cognitive skills acquired and implemented later in the workplace. It showed that the graduates were competently learning and applying cognitive-related skills. Descriptive analysis, however, found that financial management, budgeting, and laboratory staffing skills are the least derived by students during clinical practice. Their knowledge on this aspect was very low as 49.6 % of graduates claimed to never acquire this skill during clinical practice. This is an area of improvement found in our study requiring improvement in the cognitive domain; skill lacking in financial management, budgeting, and laboratory staffing.

These skills related to lab management; are important for laboratory professionals as per a study done in the USA (Scanlan, 2013). The study emphasized that the MLS program requires education in laboratory management including labor laws, safety laws, budget preparation, and management techniques, staff supervision in the laboratory. This management experience will help the lab professionals to have the basic laboratory management and will furthermore help them to interpret budgets and educate new professionals (Scanlan, 2013).

Another study was done by (Gardner and Estry, 1990) also found that the technical job responsibilities are expanding and require proficiency in budget control, quality assurance, and lab management aspects. This further supports the requirement for deriving management skills among the graduates during clinical practice. Henceforth, the lack of these skills among graduates need to be addressed.

Our analysis is also supported by another study from North Carolina University (Susan J Beck & Kathy Doig, 2002) that assessed the entry-level competencies for lab personnel. The study recommend enhancing the management skills for the lab practitioners to grow in their careers. The managers and clinical practitioners agreed

that the lab staff personnel need more management and administrative skills in the future and will spend more time-solving problems compare to laboratory testing techniques.

As per (Susan J Beck & Kathy Doig, 2002) the majority of the competencies related to management will become an integral and essential part of lab work after three to five years of work practice. As our study revealed that graduates are least oriented on the skills related to lab management henceforth, for adapting them to changing lab environment more stress should be given to developing this skill in the cognitive domain.

The cognitive skill for critical analysis, problem-solving, and decision making has been considered a key skill required for lab professionals (Beadling & Vossler, 2001; Beck & Boig, 2007; Greer, 2008). The employers also felt that critical thinking skills in entry-level lab technologist would improve the quality of patients care (Greer, 2008). However, a psychological study shows that only 30 % of students can apply critical thinking skill to solve problems (H. G. Schmidt & Mamede, 2020).

Our findings also claim that the second least developed skill in the cognitive domain is related to critical thinking and problem-solving. 11.9% of graduates claimed to never develop this skill during clinical practice. These results are in alignment with a study by (Brock RN. & Butts RN., 1998) stating that clinical laboratory professionals needs more training in critical thinking skills.

Psychomotor abilities are movement-oriented skills that integrate the theoretical and practical aspect of a course as supported by many literature reviews. (Edward, 2002; Feisel & Rosa, 2005; Salim, Puteh, & Daud, 2012). As these skills, help students to transfer their knowledge to practical work at labs hence are of high importance during clinical training (Shaban, Khater, & Akhu-Zaheya, 2012). In addition, while getting

engaged in performing lab experiments helps students to develop the practical skills and hands on skills during clinical training.(HUNTER, MCCOSH, & WILKINS, 2003; Salim et al., 2012; Watai, Brodersen, & Brophy, 2007).

In clinical practice, success ultimately requires the incorporation of both knowledge and psychomotor expertise. Our study-illustrated graduates were not proficient in research skills related to planning and designing experiment. The other skills related to oral presentation and report writing were among the students' least developed abilities. Another similar study was done by (Madson, Aten, & Leach, 2007) also found the similar findings in which concerns were raised due to lack of writing skills among graduates.

The similar concerns were addressed in a study that graduate program prepared students well for the more general aspects emphasizing high-quality information but provided inadequate information related to writing process, for example report writing (Madson et al., 2007). As report writing is the required proficiency in the real job market (Neeley, Hinds, & Cramton, 2012) this discrepancy needs to be addressed during clinical training.

A comparison between the deriving and application of psychomotor domain skills revealed a discrepancy. In addition, graduates working in diagnostic laboratory settings used the psychomotor skills well compared to those working in non-diagnostic laboratory settings i.e. graduates working in research labs.

The affective domain relates to skills required to thrive in their personal and professional lives. These affective skills refer to behaviors and attitudes that students need to acquire during clinical practice. As science is not only related to performing experiments but also includes affective skills (Wetherell, 2012). It was satisfying that

the affective domain skills have been gained proficiently compared to skills in other domains.

In the affective domain the skills related to team working are of high importance for the lab technicians as they help them to be increase their productivity at work and enhance their innovative capacity (Nowrouzian & Farewell, 2013). It was satisfying that Skill related to team working was derived well by students. Another important skill in affective domain required to work in lab settings is the time management. As time sensitivity in healthcare is related to quality services so, it's important to incorporate this skill (Özel & Duzcu). During clinical training 64.8% graduates derived the time management skill and satisfactorily 52.2% graduates applied time management at their jobs.

Our study in the affective domain showed that the skill related to taking their initiative to learn was developed very well by the student. The graduates agreed that they can take their initiative proficiently after they finished their training and started working. This was similar to a study done in Lebanon for pharmacy graduates (Nasser, Saad, & Karaoui, 2016) where 71 % of graduates agreed that their skill relates to learning was enhanced strongly with clinical training.

Although skills related to affective domain were derived well by the students however, a minimal of 7.8% graduates claimed to not derive the affective skills during clinical practice. The affective skills derived and used showed a discrepancy. A statistical difference was also found in the affective skills used by the graduates working in different laboratory settings. Those working in diagnostic settings were applying more affective skills compared to those working in non-diagnostic settings.

Another significant finding of study stated that graduates in group 2, working in non-diagnostic labs did not apply the cognitive, psychomotor, and affective skills as

effectively as graduates in group 1 who worked in diagnostic labs. The graduates of group 2 raised concerns that research lab preparation was limited. Their skills to perform manual experiments were limited as clinical training was on automated machines henceforth, and the graduates working as research assistants in research labs were less competent at work.

This was furthermore clarified as in Hamad Hospital corporation lab settings the diagnostic labs are automated as they receive a large pool of samples daily and training is also provided on automated machines during clinical training. On the contrary, working as a research assistant in non-diagnostic or research labs require more manual skills to run different research experiments. This supports the graduate group two perspective of less use of skills as they are only trained on automated machines which are less required in research labs.

The graduates working as lab technologists were applying the skills gained very well at their workplace as they were working in diagnostic lab settings (Harmening, Castleberry, & Lunz, 1995). They were fully trained on automated machines and were applying the same skills very well while working in diagnostic labs at Hamad Medical Corporation labs or Qatar Biobank.

However, 51.3% graduates in our study cohort demonstrated the interest in working at research labs supported by findings of (Willison & O'Regan, 2007) the training in research labs should be emphasized during clinical practice. Henceforth, the clinical training should include rotation in research lab settings also.

The open question asked from the students related to suggestions for improving the course improved the response quality and shed light on aspects further required to be addressed while structuring clinical training. (Smyth, Dillman, Christian, & Mcbride, 2009). Graduates were reasonably satisfied with the department's

performance in providing training at Qatar's leading health-care institute, but they expressed some suggestions related to rotation in different labs. The students wanted improvement in immunology laboratory training. The students further added that in immunology laboratory rotation they were only given theoretical information and lacked any practical training.

The Blood Bank and Chemistry departments were of the most value and practical experience, but students raised concerns about working with expired samples and kits during their training. They expressed interest in working with real patient samples to be more competent and confident at work later. This will furthermore help to reduce errors by these graduates while working as lab technicians in blood bank (Karni, 1991). As blood bank department requires competency to work with patient samples henceforth this concern needs to be addressed in the clinical training (Hollensead, Lockwood, & Elin, 2004).

A few graduates have expressed an interest in including Bioinformatics in the clinical training program, claiming it to be a highly competitive and exciting area in terms of work prospects in the future (Bravo-Egana et al., 2019). This is furthermore supported by a study related to use of bioinformatics basic training requirement by lab technologist to achieve competency and efficacy in their lab work (Hauenstein, Deeb, Matthews, Williams, & Saxe, 2019).

This study as per our best knowledge to date accounts to be unique in the Middle Eastern region and henceforth could not be compared with the students' satisfaction rate on clinical training from other universities. In the future, the same study can be carried out by enrolling biomedical graduate students from other universities to understand students' perspectives on a large scale, and then the later comparison can be made to understand the gaps in clinical training.

CHAPTER 6: LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

*6.1 Limitations*

The study had a major limitation of conducting a telephonic survey due to the global pandemic of COVID-19. The telephonic interview was timesaving and quick however, data related to actions and observation of the participants i.e. Behavioral Data could not be assessed**.** In addition, as the telephonic survey was long and required time devotion from the participants henceforth added to the frustration of few participants. Another important aspect worth mentioning is that the database provided by the graduate office included old telephone numbers as students did not update their new contact numbers. These graduates traveled outside the country for studies or got married henceforth-new telephone numbers were not provided to the graduate office. These led to a reduction in sample size for the survey.

*6.2 Conclusion*

The study was designed to understand student's perspectives on clinical training as it prepares graduates with all skills and expertise required for real work challenges. An internship is considered a pre-professional work experience that helps students to gain expertise and skills needed in the future careers (Rahman, Khatun, & Mezbah-ul-Islam, 2008). Henceforth this study contributed to understanding discrepancies in skills derived and achieved by the graduates. In addition, as it included graduate's opinions and suggestions going through the experience of training themselves added more value to the findings. The results did reveal that there are existing gaps between the skills derived and applied by the graduates at their workplaces. The filling of these gaps will help to improve the clinical training program and furthermore provide the healthcare sector with a more efficient workforce.

6.3 Recommendations

The gaps mentioned in the study can be bridged well by enhancing the management skills, critical analysis skills, and research skills during clinical practice. Skills related to lab management can be improved if the clinical training allocates a few hours per day to students during which they assist the lab managers in their daily activities. In addition, students should also take initiative themselves in volunteering lab management-related tasks. The students should be encouraged more during clinical practice to have journal club discussions on peer-reviewed papers so that they improve their research as well as critical analysis skills. Another important skill related to report writing needs to be enhanced among students. This skill can be improved by providing more opportunities to graduates during training to write lab reports under supervision of senior lab technicians. This study further unveiled an important aspect related to graduates' choice of profession that they are interested in working at research labs and exploring bioinformatics field also henceforth, training in research labs and bioinformatics labs should be incorporated in the clinical training.

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# APPENDICES

## APPENDIX A: IRB APPROVAL

**Qatar University Institutional Review Board QU-IRB**
QU-IRB Registration: IRB-QU-2020-006, QU-IRB, Assurance: IRB-A-QU-2019-0009

September 1st, 2020

Dr. Marwan Abu Madi
College of Health Sciences
Qatar University
Phone: 4403 4791
Email: abumadi@qu.edu.qa

Dear Dr. Marwan Abu Madi,

**Sub.: Research Ethics Expedited Approval**
**Ref.: Taghreed Abunada; e-mail: taghreed.abunada@qu.edu.qa**
**Project Title: "Evaluation of laboratory clinical training internship of a NAACLS accredited program in Qatar: Graduates perspective"**

We would like to inform you that your application along with the supporting documents provided for the above project, has been reviewed by the QU-IRB, and having met all the requirements, has been granted research ethics **Expedited Approval** based on the following category(ies) listed in the Policies, Regulations and Guidelines provided by MOPH for Research Involving Human Subjects. Your approval is for one year effective from September 1st, 2020 till August 30th, 2021.

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1) *present no more than minimal risk to human subject, and*
2) *involve only procedures listed in the following category(ies).*
**Category 7:** Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

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**Documents Reviewed:** QU-IRB Application Human Subject- Ver 2_Bilingual_V2_24_08_2020, Informed consent form (002)_V2_24_08_2020, Attachment 1_Telephone script_V2_24_08_2020, QU-IRB Application Material Check List., QU_Research Protocol_23 June 2020_V1, Attachment 2_ Telephone Questionnaire Data collection_20 June 2020 _ V1, QU-IRB Review Forms, responses to IRB queries and updated documents.

Please note that expedited approvals are valid for a period of **one year** and renewal should be sought one month prior to the expiry date to ensure timely processing and continuity. Moreover, any changes/modifications to the original submitted protocol should be reported to the committee to seek approval prior to continuation.

Your Research Ethics Expedited Approval Number is: **QU-IRB 1360-EA/20**. Kindly state this number in all your future correspondence to us pertaining to this project. In addition, please submit a closure report to the QU-IRB upon completion of the project.

Best wishes,
Dr. Ahmed Awaisu
Chairperson, QU-IRB

**Institutional Review Board ( IRB) Office Of Academic Research**
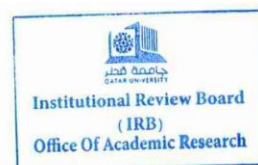
APPENDIX B: ONLINE INFORMED CONSENT

**Part I:**

Informed consent form for biomedical laboratory sciences graduates and who we are inviting to participate in this study via a telephone questionnaire. The approximate number of participants in this study is 150 graduates. The study titled; "Evaluation of laboratory clinical training internship of a NAACLS accredited program in Qatar: Graduates perspective".

The research Principal Investigator (PI) may be contacted for any inquiry as stated below:

Dr. Marwan Abu Madi

Associate Professor,

Head of Biomedical Science Department,

College of Health Sciences, Doha, Qatar, P.O. Box 2713

Tel: +974 4403 4791

e-mail: abumadi@qu.edu.qa

**Purpose of this study;**

Training internships in biomedical laboratory science programs is important to consolidate the practical experience and theoretical knowledge of biomedical graduates. Up to date, this study would be the first survey in Qatar that provides an overview of;

1. The biomedical laboratory science graduates in relation to the clinical training internship program offered by the faculty of Biomedical Sciences, Qatar University in collaboration with the Department of Laboratory, Medicine, and Pathology,

Hamad Medical Corporation.

2. *A discrepancy between the knowledge and skills developed in undergraduate study and those actually required in post-graduation activities and career.*

3. *Knowledge and skills required by the labour market*

**Type of Research Intervention**

Participants have to sign the consent form via Google's link if they are willing to participate in this study. Moreover, the researcher will contact participants via telephone to collect the questionnaire's answers, in which the phone interview will take about 20-30 minutes.

**Participant Selection**

The study sample consists of Qatar University graduates of Biomedical Sciences in the last five years (2015 -2019).

**Procedure**

Graduates' feedback about their clinical academic training in the Biomedical Science program will be used to identify areas of weakness and strengths. The provided information is confidential, names are not being included on the forms, and only numbers will identify them, and no one else except the PI and Co-PI will have access to the information.

**Risks**

Of note, we will not ask the participant to share personal beliefs, practices, or stories and you do not have to share any knowledge that you are not comfortable sharing.

**Benefits**

There is no direct benefit to participants; however, participant's response is likely to help us to investigate whether the QU curriculum and the clinical academic training internship program prepared those graduates optimally for their jobs and whether they were technically competent at their work placement

**Reimbursements**

Participants will not be provided with an incentive to take part in the study.

**Sharing the Results**

Each participant will receive a summary of the results. The overall study results will be published in an academic peer-review journal.

**Right to Refuse or Withdraw**

The participants are able to withdraw from the phone interview at anytime. At the end of the phone interview, the researcher will give participants enough time to review their answers.

**Who to Contact**

The research Principal Investigator (PI) may be contacted for any inquiry as stated below:

Dr Marwan Abu Madi

Associate Professor,

Head of Biomedical Science Department,

College of Health Sciences, Doha, Qatar, P.O. Box 2713

Tel: +974 4403 4791

e-mail: abumadi@qu.edu.qa

This study is approved by the Qatar University Institutional Review Board with the approval number…………………; If you have any question related to the ethical compliance of the study you may contact them at QU-IRB@qu.edu.qa.

**Part II: Certificate of Consent**

I have read the foregoing information. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study and I do agree to be contacted by the research team through the phone.

Name of Participant:_____

Telephone number: _____

Preferred time to be contacted: _____

Signature of Participant: _____

Date: _____

**Researcher/person taking consent**

I have accurately read out the information sheet participant, and to the best of my ability made sure that the participant understands

I confirm that the participant was given an opportunity to ask questions about the

study, and all the questions asked by the participant have been answered correctly, and the consent has been given freely and voluntarily.


Signature of Researcher /person taking the consent_____

Date _____

APPENDIX C: TELEPHONE QUESTIONNAIRE

**2.**

| Demographic | | |
|---|---|---|
| Graduation | Year _____ Semester _____ | |
| QU Clinical internship | Year _____ Semester _____ | |
| GPA at the time of graduation (optional) | | |
| Educational level | | |
| Clinical internship site | € HMC | € SIDRA |
| Nationality | € Qatari | € Non-Qatari (specify …………..) |
| Profession status | € Employed | € engaged in training |
| If employed, Job title | | |
| Joining date | | |
| Employer name | | |
| Lab Specialty or section(s) | € Hematology € chemistry € immunology € Virology € Microbiology € Blood Bank € Molecular/Genetics € Research lab | |

| | |
|---|---|
| 3. | |

How satisfied are you with the **CONTENT** of the Clinical Training Internship Program offered by Qatar University in term of?
**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

**Organization**

Objectives were clearly stated. Written procedures were readily available.

**Content**

The material was presented at an appropriate difficulty level. Instruction enabled me to understand & utilize procedures. There were sufficient samples available to perform, repeat and practice the required procedures.

**Evaluation criteria**

The grading system was clearly explained. Exams and assignments were fair. Exams reflected the objectives & rotations' content.

**Length**

The amount of time allocated for the rotations was appropriate. Time was well utilized.

How satisfied are you with the **CLINICAL INSTRUCTORS** of the Clinical Training Internship Program offered by Qatar University in term of the below components?
**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

**Instructor's Attitude**

| | |
|---|---|
| The instructor made you feel welcome and part of the laboratory team. The instructor exhibited openness to student ideas and questions. The instructor inspired me to put forth my best effort and had a positive attitude. | |
| **Command of Material/Knowledge/Expertise** | |
| The instructor appeared knowledgeable in the subject matter. | |
| **Ability to Convey Knowledge and Expertise** | |
| The instructor communicated the subject matter well. The Instructor perceived the student's ability and adjusted pace accordingly. The instructor presented information in an interesting and thought-provoking manner. | |
| **Interest in Teaching** | |
| The instructor appeared to be interested in teaching students. Instructor demonstrated enthusiasm | |

4.

5.

For your undergraduate degree, please indicate how well the clinical training internship assisted you in **DEVELOPING** the knowledge and skills required in your profession and how well such knowledge and skills were **USED** in your current profession?

**"0 = Not at all, 1 = little, 2 = to some extent, 3 = well, 4 = very well"**

| Knowledge/skills | Internship Efficiency score in term of developed knowledge/skills During undergraduate | Internship Efficiency score in term of used knowledge/skills in your degree profession |
|---|---|---|
| **Cognitive Domain** | | |
| Recall of basic knowledge and comprehension | | |
| Awareness of organizational structure, management, safety, infection prevention control measures, quality management | | |
| Awareness of financial management, budget, staffing, HR laws and regulation of the degree profession. | | |
| Application and interpretation of content/results | | |
| Critical analysis, decision-making, and problem-solving, which relates to the evaluation and processing of knowledge. | | |
| Ability to retrieve/locate information from a range of sources | | |
| Total cognitive score | | |
| **Psychomotor Domain** | | |

| | |
|---|---|
| Readiness; an awareness of and ready to analyze samples or observe | |
| Competence and confidence with performing a task or analyzing samples | |
| Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations | |
| Research skills (e.g. planning and design experiments) | |
| Information and communication technology skills | |
| Report writing and written communication skills | |
| Oral presentation and verbal communication | |
| Total psychomotor score | |
| **Affective Domain** | |
| Appreciation of ethical scientific behaviour | |
| Leadership skills | |
| Team working skills | |
| Time management and organizational skills | |
| Ability to use own initiative | |
| The ability of independent learning required for continuing professional development | |
| Total Affective score | |
| How may the program improve its **CURRICULUM** to match the need of the labour market more from your point of view (open question)? | |

## APPENDIX D: EXAMPLES OF TELEPHONE QUESTIONNAIRE

**Example -1**

| | | |
|---|---|---|
| **Demographic** | | |
| **Graduation** | Year ___2016_____ | Semester Fall_____ |
| **QU Clinical internship** | Year ____2016_____ | Semester Fall_____ |
| **GPA at time of graduation (optional)** | | |
| **Educational level** | Msc Biomedical Sciences | |
| **Clinical internship site** | ☐ HMC          ☐ SIDRA | |
| **Nationality** | ☐ Qatari       ☐ Non-Qatari (specify …………..) | |
| **Profession status** | ☐ Employed      ☐ engaged in training | |
| **If employed, Job title** | Research Assistant | |
| **Joining date** | BRC,QU(2019) | |
| **Employer name** | Qatar University | |
| **Lab Specialty or section(s)** | ☐ Hematology ☐ chemistry   ☐ immunology  ☐ Virology  ☐ Microbiology ☐ Blood Bank  ☐ Molecular/Genetics      ☐ Research lab | |

**How satisfied are you with the CONTENT of the Clinical Training Internship Program offered by Qatar University in term of?**
**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

| | |
|---|---|
| **Organization** | |
| **Objectives were clearly stated. Written procedures were readily available.** | 3 |
| **Content** | |
| **Material was presented at an appropriate difficulty level. Instruction enabled me to understand & utilize procedures. There were sufficient samples available to perform, repeat and practice the required procedures.** | 2 |
| **Evaluation criteria** | |
| **The grading system was clearly explained. Exams and assignments were fair.Exams reflected the objectives & rotations' content.** | 3 |
| **Length** | |
| **The amount of time allocated for the rotations was appropriate. Time was well utilized.** | 1 |

**How satisfied are you with the CLINICAL INSTRUCTORS of the Clinical Training Internship Program offered by Qatar University in term of ?**
**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

| | |
|---|---|
| **Instructor's Attitude** | |
| **Instructor made you feel welcome and part of the laboratory team. Instructor exhibited** | 2 |

| | |
|---|---|
| openness to student ideas and questions. Instructor inspired me to put forth my best effort and had a positive attitude. | |
| **Command of Material/Knowledge/Expertise** | |
| Instructor appeared knowledgeable in the subject matter. | 3 |
| **Ability to Convey Knowledge and Expertise** | |
| Instructor communicated the subject matter well. Instructor perceived student's ability and adjusted pace accordingly. Instructor presented information in an interesting and thought-provoking manner. | 3 |
| **Interest in Teaching** | |
| Instructor appeared to be interested in teaching students. Instructor demonstrated enthusiasm | 3 |

**With respect to your undergraduate degree, please indicate how well the clinical training internship assisted you in DEVELOPING the knowledge and skills required in your profession and how well such knowledge and skills were USED in your current profession?**

"0 = Not at all, 1 = little, 2 = to some extent, 3 = well, 4 = very well"

| Knowledge/skills | Internship Efficiency score in term of developed knowledge/skills During undergraduate | Internship Efficiency score in term of used knowledge/skills in your degree profession |
|---|---|---|
| **Cognitive Domain** | | |
| Recall of basic knowledge and comprehension | 4 | 0 |
| Awareness of organizational structure, management, safety, infection prevention control measures, quality management | 4 | 2 |
| Awareness of financial management, budget, staffing, HR laws and regulation of the degree profession. | 0 | 0 |
| Application and interpretation of content/results | 4 | 0 |
| Critical analysis, decision-making, and problem solving, which relates to the evaluation and processing of knowledge. | 0 | 0 |
| Ability to retrieve/locate information from a range of sources | 0 | 0 |
| **Total cognitive score** | 12 | 2 |
| **Psychomotor Domain** | | |
| Readiness; an awareness of and ready to analyze samples or observe | 2 | 0 |

| | | |
|---|---|---|
| **Competence and confidence with performing a task or analyzing samples** | 4 | 0 |
| **Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations** | 0 | 0 |
| **Research skills (e.g. planning and design experiments)** | 0 | 0 |
| **Information and communication technology skills** | 4 | 0 |
| **Report writing and written communication skills** | 0 | 0 |
| **Oral presentation and verbal communication** | 2 | 0 |
| **Total psychomotor score** | 12 | 0 |
| **Affective Domain** | | |
| **Appreciation of ethical scientific behavior** | 4 | 0 |
| **Leadership skills** | 4 | 2 |
| **Team working skills** | 4 | 2 |
| **Time management and organizational skills** | 4 | 4 |
| **Ability to use own initiative** | 4 | 4 |
| **Ability of independent learning required for continuing professional development** | 4 | 4 |
| **Total Affective score** | 24 | 16 |

**How may the program improve its CURRICULUM to match the need of the labor market more from your point of view (open question)?**

**Immunology and Virology labs require more training as I struggled in these labs**

**Example 2**

| | |
|---|---|
| **Demographic** | |
| **Graduation** | Year __2018 Semester Fall_____ |
| **QU Clinical internship** | Year ____2018_____ Semester Fall_____ |
| **GPA at time of graduation (optional)** | |
| **Educational level** | Bsc Biomedical Sciences |
| **Clinical internship site** | ☐ HMC ☐ SIDRA |
| **Nationality** | ☐ Qatari ☐ Non-Qatari (specify …………..) |
| **Profession status** | ☐ Employed ☐ engaged in training |
| **If employed, Job title** | Laboratory Technologist |
| **Joining date** | 2019 |
| **Employer name** | HMC |
| **Lab Specialty or section(s)** | ☐ Hematology ☐ chemistry ☐ immunology |

☐ Virology  ☐ Microbiology ☐ Blood Bank

☐ Molecular/Genetics      ☐ Research lab

**How satisfied are you with the CONTENT of the Clinical Training Internship Program offered by Qatar University in term of?**

**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

| | |
|---|---|
| **Organization** | |
| **Objectives were clearly stated. Written procedures were readily available.** | 3 |
| **Content** | |
| **Material was presented at an appropriate difficulty level. Instruction enabled me to understand & utilize procedures. There were sufficient samples available to perform, repeat and practice the required procedures.** | 3 |
| **Evaluation criteria** | |
| **The grading system was clearly explained. Exams and assignments were fair.Exams reflected the objectives & rotations' content.** | 3 |
| **Length** | |
| **The amount of time allocated for the rotations was appropriate. Time was well utilized.** | 3 |

**How satisfied are you with the CLINICAL INSTRUCTORS of the Clinical Training Internship Program offered by Qatar University in term of ?**

**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

| | |
|---|---|
| **Instructor's Attitude** | |
| **Instructor made you feel welcome and part of the laboratory team. Instructor exhibited openness to student ideas and questions. Instructor inspired me to put forth my best effort and had a positive attitude.** | 2 |
| **Command of Material/Knowledge/Expertise** | |
| **Instructor appeared knowledgeable in the subject matter.** | 3 |
| **Ability to Convey Knowledge and Expertise** | |
| **Instructor communicated the subject matter well. Instructor perceived student's ability and adjusted pace accordingly. Instructor presented information in an interesting and thought-provoking manner.** | 3 |
| **Interest in Teaching** | |
| **Instructor appeared to be interested in teaching students. Instructor demonstrated enthusiasm** | 3 |

**With respect to your undergraduate degree, please indicate how well the clinical training internship assisted you in DEVELOPING the knowledge and skills required**

in your profession and how well such knowledge and skills were USED in your current profession?
"0 = Not at all, 1 = little, 2 = to some extent, 3 = well, 4 = very well"

| Knowledge/skills | Internship Efficiency score in term of developed knowledge/skills During undergraduate | Internship Efficiency score in term of used knowledge/skills in your degree profession |
|---|---|---|
| **Cognitive Domain** | | |
| **Recall of basic knowledge and comprehension** | 3 | 3 |
| **Awareness of organizational structure, management, safety, infection prevention control measures, quality management** | 3 | 3 |
| **Awareness of financial management, budget, staffing, HR laws and regulation of the degree profession.** | 2 | 2 |
| **Application and interpretation of content/results** | 3 | 3 |
| **Critical analysis, decision-making, and problem solving, which relates to the evaluation and processing of knowledge.** | 3 | 3 |
| **Ability to retrieve/locate information from a range of sources** | 3 | 3 |
| **Total cognitive score** | 17 | 17 |
| **Psychomotor Domain** | | |
| **Readiness; an awareness of and ready to analyze samples or observe** | 4 | 3 |
| **Competence and confidence with performing a task or analyzing samples** | 4 | 4 |
| **Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations** | 3 | 4 |
| **Research skills (e.g. planning and design experiments)** | 4 | 4 |
| **Information and communication technology skills** | 3 | 3 |
| **Report writing and written communication skills** | 4 | 4 |
| **Oral presentation and verbal communication** | 3 | 4 |
| **Total psychomotor score** | 25 | 26 |
| **Affective Domain** | | |
| **Appreciation of ethical scientific behavior** | 4 | 4 |
| **Leadership skills** | 3 | 4 |

| | | |
|---|---|---|
| **Team working skills** | 4 | 4 |
| **Time management and organizational skills** | 4 | 4 |
| **Ability to use own initiative** | 4 | 4 |
| **Ability of independent learning required for continuing professional development** | 4 | 4 |
| **Total Affective score** | 23 | 24 |

**How may the program improve its CURRICULUM to match the need of the labor market more from your point of view (open question)?**

**Overall satisfied and was happy with all aspects of training**

**Example 3**

| Demographic | |
|---|---|
| **Graduation** | Year __2017 Semester Spring_____ |
| **QU Clinical internship** | Year ____2017_____ Semester Spring |
| **GPA at time of graduation (optional)** | |
| **Educational level** | Bsc Biomedical Sciences |
| **Clinical internship site** | ☐ HMC ☐ SIDRA |
| **Nationality** | ☐ Qatari ☐ Non-Qatari (specify …………..) |
| **Profession status** | ☐ Employed ☐ engaged in training |
| **If employed, Job title** | Research Assistant |
| **Joining date** | 2019 |
| **Employer name** | BRC,QU |
| **Lab Specialty or section(s)** | ☐ Hematology ☐ chemistry ☐ immunology<br>☐ Virology ☐ Microbiology ☐ Blood Bank<br>☐ Molecular/Genetics ☐ Research lab |

**How satisfied are you with the CONTENT of the Clinical Training Internship Program offered by Qatar University in term of?**
**"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"**

| | |
|---|---|
| **Organization** | |
| **Objectives were clearly stated. Written procedures were readily available.** | 4 |
| **Content** | |
| **Material was presented at an appropriate difficulty level. Instruction enabled me to understand & utilize procedures. There were sufficient samples available to perform, repeat and practice the required procedures.** | 2 |
| **Evaluation criteria** | |

| | |
|---|---|
| The grading system was clearly explained. Exams and assignments were fair.Exams reflected the objectives & rotations' content. | 3 |
| **Length** | |
| The amount of time allocated for the rotations was appropriate. Time was well utilized. | 1 |

**How satisfied are you with the CLINICAL INSTRUCTORS of the Clinical Training Internship Program offered by Qatar University in term of ?**
"0 = very unsatisfied, 1 = unsatisfied, 2 = neutral/undecided, 3= satisfied, 4 = very satisfied"

| | |
|---|---|
| **Instructor's Attitude** | |
| Instructor made you feel welcome and part of the laboratory team. Instructor exhibited openness to student ideas and questions. Instructor inspired me to put forth my best effort and had a positive attitude. | 2 |
| **Command of Material/Knowledge/Expertise** | |
| Instructor appeared knowledgeable in the subject matter. | 2 |
| **Ability to Convey Knowledge and Expertise** | |
| Instructor communicated the subject matter well. Instructor perceived student's ability and adjusted pace accordingly. Instructor presented information in an interesting and thought-provoking manner. | 3 |
| **Interest in Teaching** | |
| Instructor appeared to be interested in teaching students. Instructor demonstrated enthusiasm | 3 |

**With respect to your undergraduate degree, please indicate how well the clinical training internship assisted you in DEVELOPING the knowledge and skills required in your profession and how well such knowledge and skills were USED in your current profession?**
"0 = Not at all, 1 = little, 2 = to some extent, 3 = well, 4 = very well"

| Knowledge/skills | Internship Efficiency score in term of developed knowledge/skills During undergraduate | Internship Efficiency score in term of used knowledge/skills in your degree profession |
|---|---|---|
| **Cognitive Domain** | | |
| Recall of basic knowledge and comprehension | 2 | 2 |
| Awareness of organizational structure, management, safety, infection prevention control measures, quality management | 4 | 2 |

| | | |
|---|---|---|
| **Awareness of financial management, budget, staffing, HR laws and regulation of the degree profession.** | 0 | 0 |
| **Application and interpretation of content/results** | 3 | 1 |
| **Critical analysis, decision-making, and problem solving, which relates to the evaluation and processing of knowledge.** | 2 | 2 |
| **Ability to retrieve/locate information from a range of sources** | 2 | 2 |
| **Total cognitive score** | 13 | 9 |
| **Psychomotor Domain** | | |
| **Readiness; an awareness of and ready to analyze samples or observe** | 2 | 2 |
| **Competence and confidence with performing a task or analyzing samples** | 2 | 0 |
| **Proficiency and adaptation, ability to alter performance successfully when encountering unexpected lab results or having new situations** | 2 | 0 |
| **Research skills (e.g. planning and design experiments)** | 0 | 0 |
| **Information and communication technology skills** | 1 | 0 |
| **Report writing and written communication skills** | 0 | 0 |
| **Oral presentation and verbal communication** | 0 | 0 |
| **Total psychomotor score** | 7 | 2 |
| **Affective Domain** | | |
| **Appreciation of ethical scientific behavior** | 4 | 4 |
| **Leadership skills** | 2 | 1 |
| **Team working skills** | 2 | 1 |
| **Time management and organizational skills** | 2 | 2 |
| **Ability to use own initiative** | 1 | 1 |
| **Ability of independent learning required for continuing professional development** | 2 | 2 |
| **Total Affective score** | 13 | 11 |
| **How may the program improve its CURRICULUM to match the need of the labor market more from your point of view (open question)?** | | |
| **Rotation in research labs should be added as I work in research lab .Immunology needed more practical work** | | |