

Exploring medical laboratory scientist students' experiences during their fourth year  
clinical practice period

by

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## **DECLARATION**

By submitting this thesis, in fulfilment for the Masters of Philosophy in Health Professions Education, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Signature:

Date: 29 November 2017

## SUMMARY

Medical Laboratory Sciences (MLS) recently introduced a new degree course for professionals of laboratory medicine. The revision of the qualification has led to the re-evaluation and restructuring of the clinical practical period (CPP) by organizations that accommodate the students during their fourth year. The purpose of this study was to explore and describe the experiences of medical laboratory scientist students in a private pathology laboratory in the Western Cape, South Africa. An embedded aim of this research was the optimization of the fourth year programme.

A qualitative approach, guided by an interpretive paradigm and exploratory design, was used in this study. Focus group interviews were conducted with three groups of students of medical laboratory sciences. These included students that were either in the process of completing their CPP at the time of the study or recent graduates that completed the CPP during the years that preceded the study. Semi-structured focus group interviews were conducted, recorded and the audio-recorded data was transcribed verbatim and coded through inductive data analysis to identify themes and subthemes.

Three themes were derived from the data analysis, which represent the factors that affected student learning during the CPP namely ‘teaching-learning dynamics’; ‘workplace dynamics’ and ‘suggestions for overall improvement’.

The major findings of the research revealed that excessive workload due to perceived staff shortages was the most significant contributing factor that affected the students’ learning. The benefit of peer assisted learning and interaction with positive role models of laboratory medicine was also highlighted.

Insights into the different experiences of the MLS students provided information to address challenges students face during the CPP and how current clinical laboratory experiences contributed to students' learning and readiness for practice. Suggestions for reviewing and restructuring of current practices from both industry and university perspectives should be considered and implemented. Improved preparation and exposure to the laboratory prior to the fourth year practice period might help to optimize the CPP for future professionals of laboratory medicine.

## OPSOMMING

Mediese Laboratoriumwetenskappe (MLW) het onlangs 'n nuwe graadkursus vir professionele laboratoriummedisyne ingestel. Die hersiening van die kwalifikasie het gelei tot die herbeoordeling en herstrukturering van die kliniese praktiese tydperk (KPT) deur organisasies wat die studente gedurende hul vierde jaar akkommodeer. Die doel van hierdie studie was om die ervarings van mediese laboratoriumstudente in 'n private patologie laboratorium in die Wes-Kaap, Suid-Afrika, te ondersoek en te beskryf. 'n Dieperliggende doel van hierdie navorsing was die optimalisering van die vierdejaarsprogram.

'n Kwalitstiewe benadering, gelei deur 'n interpretatiewe paradigma en verkennende ontwerp, is in hierdie studie gebruik. Fokusgroeponderhoude is uitgevoer met drie groepe studente van mediese laboratoriumwetenskappe. Dit sluit in studente wat óf in die proses was om hul KPT te voltooi tydens die studie of onlangse gegradueerdes wat die KPT voltooi het gedurende die jare wat die studie voorafgegaan het.

Semi-gestruktureerde fokusgroeponderhoude is uitgevoer, aangeteken en die audio-opgeneemde data is woordeliks getransskribeer en gekodeer deur induktiewe data-ontleding om temas en subtemas te identifiseer.

Drie temas is afgelei van die data-analise, wat die faktore verteenwoordig wat studente leer tydens die KPT beïnvloed, naamlik 'onderrig-leer-dinamika'; 'werkplekdinamika' en 'voorstelle vir algehele verbetering'.

Die vernaamste bevindings van die navorsing het getoon dat oormatige werkslading as gevolg van personeelgebreke die grootste tekortkoming op die leerder se leer gehad het. Die voordeel van eweknie leer en interaksie met positiewe rolmodelle van laboratoriummedisyne is ook uitgelig.

Insig in die verskillende ervarings van die MLW studente het inligting verskaf om uitdagings aan te spreek wat studente tydens die KPT ervaar en hoe huidige kliniese laboratoriumervarings bygedra het tot studente se leer en gereedheid vir die praktyk. Voorstelle vir hersiening en herstrukturering van huidige praktyke vanuit beide die industrie en universiteit perspektiewe moet oorweeg en geïmplementeer word. Verbeterde voorbereiding en blootstelling aan die laboratorium voor die vierde jaar praktyk periode kan help om die KPT te optimaliseer vir toekomstige professionele van laboratoriummedisyne.

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**“I can do all things through Christ which strengthened me: Philippians 4:13”**

## Contents

DECLARATION .....	i
SUMMARY .....	ii
OPSOMMING .....	iii
ACKNOWLEDGEMENTS .....	iv
LIST OF FIGURES .....	viii
LIST OF TABLES .....	ix
1. BACKGROUND AND CONTEXT OF THE STUDY .....	1
1.1 Context of the study .....	1
1.2 Roles and responsibilities of the key role players during the fourth year CPP .....	3
1.2.1 The role and responsibilities of the researcher .....	3
1.2.2 The responsibilities of the medical laboratory sciences (MLS) students .....	4
1.2.3 The role of the various laboratories/sites .....	5
1.2.4 The role and responsibilities of the UoT .....	5
1.3 The Work-based Learning Environment .....	6
2. EXTENDED LITERATURE REVIEW .....	8
2.1 Work Based Learning .....	8
2.2 Learning theories involved in the learning of the MLS students .....	8
2.3 Teaching and learning in the private pathology industry .....	11
2.3.1 Mentoring of MLS students .....	12
2.3.2 Supervision of MLS students .....	12
2.3.3 Role modelling .....	13
2.3.4 The MLS students as part of the workforce .....	13
3. EXTENDED RESEARCH METHODOLOGY .....	15
3.1 Research design and methodology .....	15
3.2 Population and sampling .....	15
3.3 Data collection methods .....	17

3.4 Data analysis .....	19
3.5 Ethical considerations .....	20
3.6 Rigor and Trustworthiness of the research.....	21
3.7 Assumptions and limitations of the study .....	22
4. REFERENCES FOR EXTENDED LITERATURE AND METHODOLOGY REVIEWS .	23
5. THE RESEARCH ARTICLE .....	31
Abstract .....	31
1. Introduction .....	32
2. Methodology .....	33
3. Results .....	34
3.1 Theme 1: Teaching-Learning Dynamics.....	34
3.1.1 The effect of excessive workload from laboratory staff on student teaching and learning .....	35
3.1.2 Peer assisted learning .....	35
3.1.3 Role modelling in the clinical laboratory.....	36
3.1.4 Personal and professional development.....	37
3.2 Theme 2: Workplace Dynamics .....	37
3.2.1 Student expectations of the fourth year and their function in the laboratory.....	37
3.2.2 Access to learning resources in the laboratory .....	38
3.2.3 Supervision of students in the laboratory.....	38
3.3 Theme 3: Suggestions for improvement of the CPP programme.....	39
3.3.1 Student support .....	39
3.3.2 Site allocation for training of MLS students.....	40
3.3.3 Integration of the three disciplines of Clinical Pathology .....	40
4. Discussion .....	41
5. Conclusion.....	44
6. References .....	45

6. ADDENDA .....	48
Addendum A: Excerpts from Clinical Pathology Fourth Year Syllabus .....	48
Addendum B: Data Collection Tools .....	52
Addendum C: Leaflet and Consent Form .....	54
Addendum D: Excerpts From Transcripts of Focus-Group Interviews .....	57
Addendum E: Elsevier HPE Author Guidelines .....	61

## LIST OF FIGURES

Figure 1.1: Schematic overview of BHSC: MLS qualification .....	2
Figure 1.2: The role players involved in the fourth year CPP.....	3
Figure 2.1: Kolb's four-stage cycle of experiential learning .....	9
Figure 3.1: An illustrative overview of the data analysis process .....	20

## **LIST OF TABLES**

Table 3.1: Participant demographics .....	16
Table 3.2: Summary of participants per cohort and focus group .....	17

## **1. BACKGROUND AND CONTEXT OF THE STUDY**

This section provides an overview of the background and context of the study and includes the key concepts and role players in the education of medical laboratory science students and how it relates to the study.

### **1.1 Context of the study**

The Bachelor of Health Science in Medical Laboratory Science (BHSC: MLS) is a new qualification that replaced the National Diploma: Biomedical Technology in 2011 that was previously available to acquire the qualification to become a medical technologist. Cape Peninsula University of Technology (CPUT) was the first University of Technology (UoT) to offer the new revised program for Medical Technology in South Africa. The new revised qualification led to industry having to re-evaluate and re-organize their practices to accommodate these students during their practical placements.

Students are required to complete a six month Work Integrated Learning (WIL) portfolio in an accredited training laboratory during the last semester of their third year which is their first exposure to the workplace setting. In the fourth year (academically recognized as the elective, final year of the BHSc: MLS degree) students select an area of specialization from one of the following disciplines: Clinical Chemistry, Clinical Pathology, Cytogenetics, Cytopathology, Haematology, Histopathology, Immunohaematology, Immunology, Microbiology, Virology, Forensic Science and Pharmacology (“Cape Peninsula University of Technology ,”n.d.).

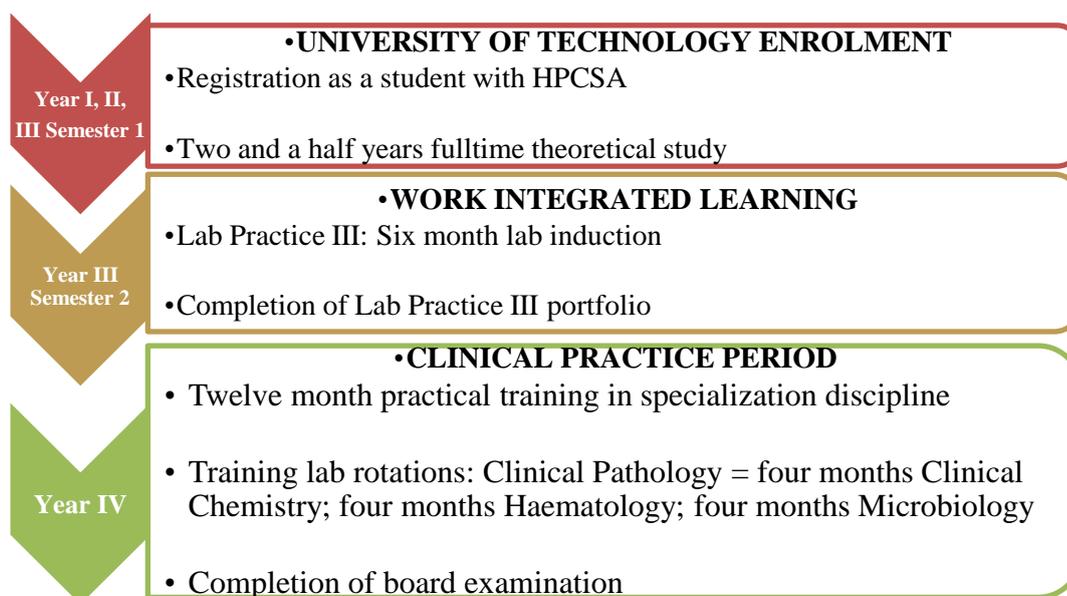
Each year various employers from both the public and private pathology sector afford the Medical Laboratory Science (MLS) students the opportunity to complete their practical period with the respective pathology organizations. During the fourth year clinical laboratory rotations, known as the clinical practice period (CPP), the MLS students are required to experience hands-on learning in their elected discipline as guided by an outcome based practical syllabus (refer addendum A).

The fourth year practical syllabus is an outline of competencies needed for the practical component of the BHSc: MLS program from both academic and employability perspectives. These guidelines are regulated by the Professional Board for Medical Technology (PBMT) of the Health Professions Council of South Africa (HPCSA) and distributed by the Society of Medical Laboratory Technologists of South Africa (SMLTSA), the administrative and representative professional bodies for the profession of Medical Technology (“The Society of

Medical Laboratory Technologists of SA,” n.d.; “Health Professions Council of South Africa,” n.d.).

The ideal is that laboratories are required to ensure that the students receive instructions and demonstrations of performing the tests contained within the practical syllabus. The intention of the CPP is to provide the students with guidance on the essential practical aspects that should be covered in order to prepare them for the HPCSA’s PBMT board examination. The board examination is the final summative assessment of the four year undergraduate degree and is written in November each year. During the examinations MLS students are required to apply theoretical principles and techniques that they studied at the university and integrate laboratory tests and results with pathophysiological conditions that they encountered during their clinical laboratory rotations.

This study was conducted with students that specialized in the discipline of Clinical Pathology, a multidiscipline component of laboratory medicine where students are required to develop academic and technical skills in three of the major areas of clinical laboratory practices: Clinical Chemistry, Haematology and Microbiology. Clinical Pathology as a fourth year elective is chosen by the largest complement of MLS students each year. This provided a larger research population as opposed to the one or two students placed in other smaller disciplines. A schematic overview of the four year qualification, relating specifically to the CPP, is summarized in Figure 1.1 below:



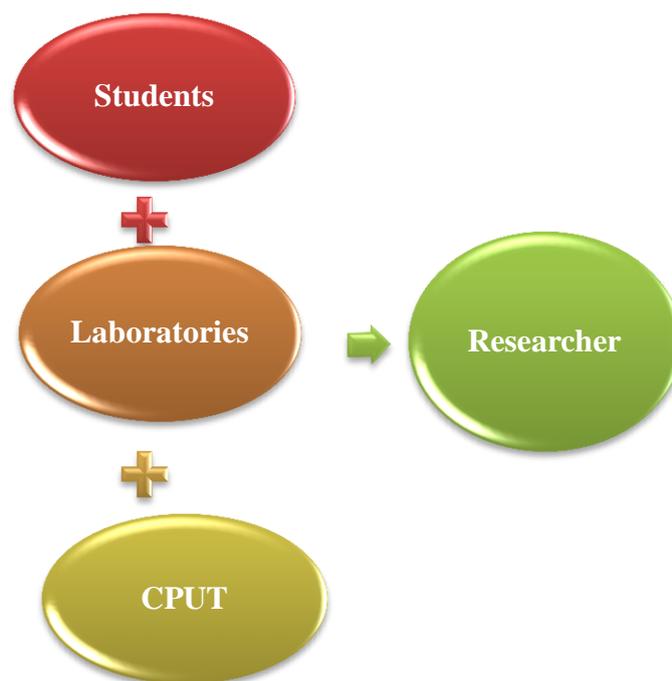
**Figure 1.1: Schematic overview of BHSC: MLS qualification**

In the next sections the context is going to be further explained by looking at the various roles the lecturer, in this case also the researcher as well as the students placed at Pathcare have in the program.

## 1.2 Roles and responsibilities of the key role players during the fourth year CPP

### 1.2.1 The role and responsibilities of the researcher

The researcher is affiliated to the academic component of the organization, known as the Academy, where she serves as a training and development specialist. The primary role of the researcher is that of the coordinator of the fourth year program. In her capacity as the coordinator she recruits fourth year students from CPUT and schedules the laboratory rotations at the various laboratories and sites. She also liaises between the various laboratories and CPUT. The association between the various role players involved in the fourth year in relation to the researcher is shown below in Figure 1.2.



**Figure 1.2: The role players involved in the fourth year CPP**

As the academic component of the organization, an additional function of the Academy is to assist the MLS students in preparation of their national board examination. This is done by scheduling revision tutorials and mock examinations, based on both theoretical and practical knowledge, which the students acquired throughout their studies. All assessments are in the

form of written examinations. Assistance with preparation of the board exam varies between organizations and is not a compulsory component of the CPP and/or required from employers. The choice for academic assistance with the board exam was an organizational decision made by the head of the Academy with the inception of the Academy in 2006 and has been continued since then.

### **1.2.2 The responsibilities of the medical laboratory sciences (MLS) students**

Although the CPP is the primary component of the fourth year for the MLS students and the focus of this study, it is not the only responsibility of the students during their fourth year. In addition to completion of the practical period, the students still have to complete two additional mandatory modules required for graduation purpose. The modules are Laboratory Management and a CPUT directed retrospective research project.

The Laboratory Management module focuses on leadership/management styles and the laboratory manager's role in maintaining Quality Management Systems. It is completed during the first semester of the fourth year. The research projects are usually related to the students' discipline of choice and permission is granted by the laboratory that the students may obtain data once ethical approval is received from CPUT's Health and Wellness Sciences Research Ethics Committee.

In addition to the aforementioned modules there are also compulsory discipline specific assessments coordinated and administered by CPUT. There are three academic tests on the chosen discipline that take place throughout the year. In between all of this there are a few practical projects given to the students to complete. These projects are assessed by the workplace supervisors and moderated by the academic lecturers of CPUT. The practical projects consist of written evidence of having performed certain practical tasks in the workplace.

A final board examination is written at the end of the CPP in the module Clinical Practice IV – Discipline of choice. The examination is set by external examiners in the profession and moderated by academically appointed moderators. Students write two three-hour papers in their discipline of choice and the board examination may only be written once. It is evident from the above explanation that the students have a lot of tasks to perform during their final year and therefore have to manage their time effectively to fulfil the requirements for graduation purposes.

### **1.2.3 The role of the various laboratories/sites**

Since the fourth year is the practical component of the undergraduate degree, and a requirement for the students to complete in order to graduate, the various laboratories are critically important training sites for the students. Training of the MLS students can only take place at accredited training laboratories i.e. laboratories that have received certification from HPCSA for the purposes of training students. The Oxford dictionary (2006, p.972) defines training as “the action of teaching a person a particular skill or type of behavior”. Training in this context refers to instruction and demonstration of tests as outlined in the fourth year syllabus.

Each laboratory is assigned a mentor whose function is to oversee, guide and assist the MLS students during their laboratory rotations. In this instance a mentor refers to a qualified, more experienced employee who has been selected by the laboratory manager to take on the role of mentor in addition to their other duties. Pathcare has made provision for employees that take on the role of mentor by providing them with an extensive one week course designed specifically to teach them how to become a mentor and what it entails. By the end of the course these individuals are required to complete a portfolio with evidence on how they have applied the skills that they have acquired in their new role as mentor and their interactions with the mentees (students).

### **1.2.4 The role and responsibilities of the UoT**

As the first UoT that has implemented the new degree course, CPUT serves as the pioneers of the course and the guiding force to employers. To this extent they have appointed a clinical coordinator whose primary functions are to liaise between the workplace and the students for both 3<sup>rd</sup> and 4<sup>th</sup> year placements. In addition she oversees the research projects and the assessments that are required as part of the fourth year by CPUT that the students must pass in order to write the board exam (refer 1.1.2).

Additional responsibilities pertaining to the fourth year CPP include developing and updating practical workbooks and supervisor guides as well as subject guides for each discipline. In conjunction with the workplace she organizes site visits for feedback from students and workplace supervisors and manager. In her capacity as clinical coordinator she also deals with student matters, liaises with lecturers on student needs as well as sources and appoints external tutors where required and arranges subject tutorials.

### **1.3 The Work-based Learning Environment**

Medical Laboratory Sciences (MLS) is a discipline of applied health sciences where the emphasis is mainly on the understanding, application, and performance of clinical laboratory analyses in an accredited laboratory. This discipline of medicine is also referred to as Medical Technology and Clinical Laboratory Sciences. It encompasses laboratory personnel performing clinical laboratory tests, interpreting and reporting the results for the purpose of aiding the pathologist in diagnosis, treating and monitoring disease (Barcelo, 2016; Isabel, 2015).

In the context of laboratory sciences the laboratory becomes the learning environment that affords students the opportunity for experiential learning to acquire these skills. The term work-based learning (WBL) is used to describe this period where MLS students are provided with opportunities to integrate their theoretical knowledge and acquire the attributes required for their professional future in laboratory medicine within the workplace setting (Longmore, 2011; Morris & Blaney, 2014).

The aim of clinical laboratory rotations is that MLS students work towards practicing independently and becoming competent practitioners of laboratory medicine through gradual decrease in direction and guidance from qualified practitioners and other professional staff (Melrose, Park, & Perry, 2015). The Council for Higher Education (Winberg, Garraway, Engel-Hills, & Jacobs, 2011) has recognized that a means of addressing student development is to foster learning that is less didactic and more situated, participative, and 'real world' oriented.

The MLS students rotate through various departments during their practical rotations in order to gain practical experiences by performing diagnostic testing in a functioning laboratory under the supervision of qualified technical staff such as medical technologists and technicians. Each of the MLS students spends a designated period of four months each in Clinical Chemistry, Haematology and Microbiology. In some instances the students rotate through more than one site and part of the laboratory rotations take place in smaller satellite laboratories known as peripheral laboratories. This would introduce the students to various learning experiences and workplace cultures in each department and/or site.

The literature suggests that the experiences and perceptions of students of the clinical environment can greatly influence the degree and quality of learning that takes place during the clinical period (Chan, 2002; Dolmans, Wolfhagen, Heineman, & Scherpbier, 2008; Entwistle & Peterson, 2004; Ramani & Leinster, 2008). Cognisance must therefore be taken of the various factors of the workplace dynamics and the impact this multi-faceted environment has on student teaching and learning in the clinical laboratory. With the introduction of the new revised fourth year CPP an important aim embodied in this research is the need for the researcher to understand the dynamics that facilitate or limit the learning of the MLS students during their clinical rotations in a private pathology laboratory setting.

The description of students' views, expectations and experiences from and during their practical training in the laboratory provided valuable information for the reorganization and improvement of current practices. Optimization of the clinical practice period is the impetus and ultimate goal of this research project with an obvious impact on the educational achievement and establishment of future laboratory professionals. This led the researcher to ask the following research question:

How do medical laboratory students experience their learning during their clinical practice period?

Specific objectives:

- a. What are the factors enabling the learning of MLS students?
- b. What are the barriers that hinder the learning of the MLS students?

The laboratory as a clinical learning environment is a relatively unexplored research domain and through conducting this study, it is envisaged that a gap identified in the literature will be filled.

## **2. EXTENDED LITERATURE REVIEW**

The extended literature section presents a review of the literature that synthesizes and expands the associations between the literature and the most pertinent findings of the study.

### **2.1 Work Based Learning**

Work Based Learning (WBL) is an integral part of the educational requirements of MLS students. An expectation of graduates of laboratory medicine is that they enter the workforce with skills applicable to the setting of their particular discipline (Sand, 2014). The literature describes WBL as a multifaceted community that introduces students to an environment that can be challenging, unpredictable and constantly evolving (Baraz, Memarian, & Vanaki, 2015). During WBL emphasis is placed on industry's role to support and develop students from both an educational and organizational perspective (Brodie & Irving, 2007).

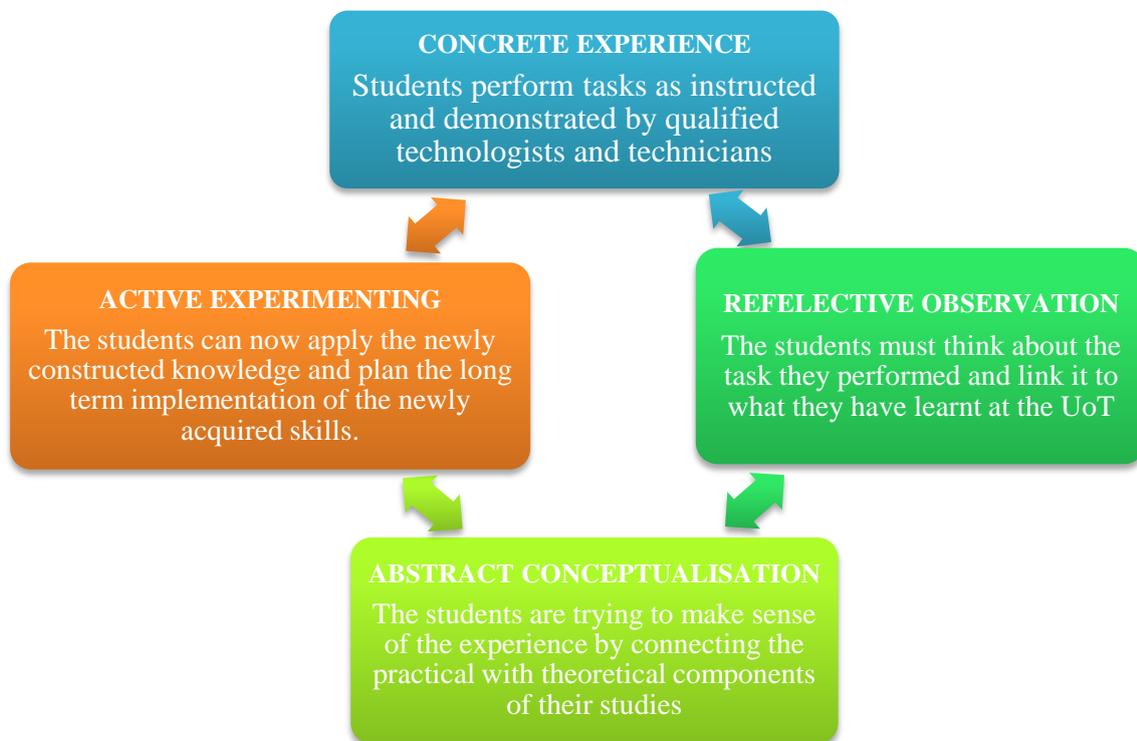
In WBL students need to develop the skills and abilities required in the workplace and learn from the knowledge and experiences encountered in the workplace within their communities of practice (Brodie & Irving, 2007). The community of practice theory (Farnsworth, Kleanthous, & Wenger-Trayner, 2016) is a collaborative process where learning is constructed in a social context between students and experienced members of the profession where the knowledge exchange process advances learning and professional identity of the group members. Knowledge is transferred from the more experienced members from the profession to novices at the brink of their career and the novice contributes to the ethos of the community of practice by providing new awareness on collaborative ways of working (Farnsworth et al., 2016; Morley, 2016).

### **2.2 Learning theories involved in the learning of the MLS students**

The social context in which learning is constructed in Wenger's community of practice theory can be linked to the theoretical orientations of experiential learning (Farnsworth et al., 2016; Miettinen, 2000). The learning of the MLS students is supported by the theories developed by Kolb. The Experiential Learning theory and the Kolb's learning cycle are some of the most widely known modern educational theories (Sharlanova, 2004) and underpin many of the teaching and learning activities used in clinical and work based education contexts (Cooper, Orrell, & Bowden, 2010). According to Kolb, Boyatzis & Mainemelis (2000) and Kolb & Kolb (2008) learning is acquired and knowledge transformed through the process of

experience. In its simplest definition experiential learning can be described as ‘learning by doing’ (Miettinen, 2000).

Kolb created a model to explain the process of experiential learning and is pertinent in representing the learning practices of the MLS students during their laboratory rotations. Experiential learning is represented as a four-stage cyclical progression where students observe, review and reflect on what they have practiced, and then intentionally link their experiences to theory or previous experiences (Kolb et al., 2000; Kolb & Kolb, 2008). Kolb’s four-stage cycle of experiential learning in the context of the MLS students, with a brief explanation of each stage in caption is illustrated in Figure 2.1 below:



**Figure 2.1: Kolb’s four-stage cycle of experiential learning [Adapted from Kolb, 2000]**

The literature has highlighted the importance of practical learning as part of the curriculum (Andrews & Roberts, 2003; Ramani & Leinster, 2008). According to Posner (2004) the official or written curriculum contains structured guidelines and outline the objectives of a particular program that forms the basis for planning educational strategies by educators. The undergraduate curriculum of medical laboratory sciences is made up of a theoretical component and a practical syllabus. Although both aspects encompass the total curriculum of the MLS students it is often treated as separate entities resulting in students expectation being

different to what the CPP actually entails. Rowe, MacKaway, & Winchester-Seeto (2012) denote in their research that a fundamental concept of practical teaching is the facilitation of theory and practice linkages between the university and the workplace. These same authors stipulate that discrepancies in the practical training of the students can result based on whether an education-led or employer-led view of the curriculum is used.

During the first three years of the education of the MLS students, CPUT provides theoretical and practical professional knowledge to prepare students for clinical laboratory placements as guided by the curriculum. The university component of the curriculum focuses mainly on diagnosing patients while the practical syllabus focuses more on laboratory tests and procedures which is what the students are expected to do learn during the CPP.

The fourth year practical syllabus outlines the competencies required for the practical components of the qualification. Upon entry into the laboratory, students often expect the same structure and organization that they experienced during their time at university. However, although guided by the syllabus, setting out sequences of learning activities in an unpredictable laboratory environment is more difficult to organize than at university. The hidden or unintended curriculum i.e. everyday workplace activities such as observing and listening to laboratory staff also contribute to the knowledge of the MLS students (Newton, Billett, Jolly, & Ockerby, 2009; Posner, 2004). Although the hidden curriculum is not officially recognized, it contributes significantly to the learning of the MLS students.

Studies on students' clinical learning experiences have shown that, principles of adult learning are foundational to an optimal learning environment (Hegenbarth, Rawe, Murray, Arnaert, & Chambers-Evans, 2015; Herod, 2002; Taylor, 2008). Adult learning refers to the formal and informal learning activities which result in the acquisition of new knowledge and skills (Mayo, 2014). Constructivism is the dominant theory underpinning the experiential learning of the MLS students and is rooted in adult learning. Learning during the laboratory rotations of the MLS students can be related to constructivism as constructivists believe that learning occurs when students acquire knowledge through their own experiences relating to the social context of their learning environment (Kim, 2001, 2006). Constructivism also encourage students to become active participants in their learning process and thus directing their own learning (Kim, 2001; Gaberson and Oermann, 2010). This involves students contributing in the selection of activities needed for a learning experience (El-Gilany & Abusaad, 2013; Tao, Li, Xu, & Jiang, 2015). These authors further suggest that clinical instructors must encourage

students to be actively involved and assume responsibility for their own learning and may also recommend other sources of learning such as through interactions with peers.

Peer-assisted learning (PAL) has been recommended as an educational strategy to complement the role of the clinical instructor and develop students' skill attainment (Al Kaws, Sausan & Hamdy, 2017; Henning, Weidner, Snyder & Dudley, 2012). Even though peers have less extensive knowledge of the subject matter, peer assisted learning allows students who share a similar knowledge base to tutor colleagues in a dialect that they understand and at a level that is on par with theirs. These same investigators also found that students tend to feel less nervous performing clinical skills in front of their peers than in front of their clinical instructors (Al Kaws, Sausan & Hamdy, 2017). PAL is of particular interest in the learning and teaching of MLS students as it can alleviate the pressures of laboratory staff in teaching the students.

### **2.3 Teaching and learning in the private pathology industry**

An additional consideration, given the setting in which the study took place, is the effect the private healthcare facilities have on student teaching and learning. Previous research emphasized that the private sector as a clinical setting prioritizes customer care and productivity as their primary function (Goh & Wait, 2003). In private pathology, the high-paced customer driven setting of the laboratory and turnaround time monitoring to release the laboratory results to doctors, remains the priority of staff and teaching often takes a secondary role. This can have negative implications for students' learning since teaching can be considered an added role to routine tasks, leading to students not receiving the necessary attention and opportunities for learning.

According to Rowe et al. (2012) organizations that hosts students during clinical teachings play a vital and complex role in experience-based learning such as WBL. This approach involves someone in the workplace or host organization 'looking after' the student. Some of the responsibilities of these laboratory professionals are to provide MLS students with general support and guidance, to induct students into the profession and the workplace, to promote professional socialization, e.g. advise students about work in the profession or area, their roles and expectations from an organizational stance (Rowe et al., 2012). The authors also advise that sometimes the multiple roles and responsibilities assigned to oversee the students are in conflict with one another. The MLS students will interact with various members of the

profession who in their capacity will either serve as a mentor, workplace supervisor and/or a role model or a combination of these roles.

### **2.3.1 Mentoring of MLS students**

As part of the inductive process into the workplace the MLS students are assigned a mentor in each department and site through which they rotate. Derived from Greek mythology, the word mentor refers to an individual who acts as teacher, role model and adviser (Anderson, 2011). The mentoring process usually involves an experienced individual guiding an inexperienced individual and is descriptive of the mentor pertaining to the MLS students (Anderson, 2011; Carter & Francis, 2001). A mentor in the context of this study is an experienced medical technologist or medical technician who has completed an approved mentorship preparation program and is competent to support and assist students in the laboratory setting.

The role of the organizational mentor in the setting of the laboratory is mainly that of a support mechanism for the students. However, the teaching process of the MLS students is often a collaborative process between the assigned mentor and various other members in the laboratory. In many instances the mentors are responsible for ensuring that the training needs of the students are met but they are not necessarily the individuals who provide the training. They designate specific tasks the students need to complete to other experienced and/or qualified staff in the laboratory who will then take on the responsibility of acting as a supervisor for the student.

### **2.3.2 Supervision of MLS students**

The supervisory relationship is an important factor in clinical laboratory learning. In the laboratory the supervisor becomes the person/s who is assigned to train the MLS students during a particular period. The intention is that those appointed as supervisors will demonstrate and observe students performing diagnostic testing in the laboratory to establish competence. Gaberson & Oermann (2010) and Lekalakala-Mokgele and Caka (2015) stated that lack of supervision in the clinical environment can be attributed to staff seeing students as extra work for them or as a result of lack of availability of staff. The acknowledgement of proper supervision as highlighted with findings in the literature (Papastavrou, Lambrinou, Tsangari, Saarikoski, & Leino-Kilpi, 2010) reiterates the importance that students must learn from practice under the supervision of clinical educators. Ramani & Krackov (2012) emphasize that performance must be observed so that acceptable and unacceptable behaviors

can be relayed to the students. The supervision functions are in addition to the routine daily duties of the laboratory personnel and therefore they may not constantly supervise the MLS students if they are busy with other duties.

### **2.3.3 Role modelling**

In many instances many employees that either serve as mentor and/or supervisor to the MLS students became a role model for them. A role model is someone who displays ethical practice, allows student to practice and enhance technical abilities and who demonstrates, shares and passes on knowledge/skills (Rowe et al., 2012). To become an effective role model Nouri, Ebadi, Alhani, & Rejeh (2013) suggests that those involved in practical education need to pay attention to both personal and environmental factors of the clinical environment. These investigators also determined that role modelling by observational learning is especially important in clinical settings as students mirror what they see, hear and observe. Further studies (Gaberson & Oermann, 2010; Sandhu, Rich, Magas, & Walker, 2015) have found that learning through observation is fundamental to role modelling.

Another aspect of role modelling highlighted in the literature is that of negative modelling. According to Melrose, Park and Perry (2015) clinical educators must not be afraid to admit when they make mistakes or on occasion display less than exemplary or prepared behaviors. Allowing students to observe errors or unscheduled interventions can be beneficial to the student's learning as they can observe the reality that clinical educators are not perfect and can also err. D'Souza, Karkada, Parahoo and Venkatesaperumal (2015) advises that clinical educators can use this as a teaching strategy by discussing and reflecting on these possible negative modelling by developing more optimal approaches in future situations.

### **2.3.4 The MLS students as part of the workforce**

The integration of students as part of the workforce is also illustrated in the literature. Students taking on the role of workers rather than that of a student in the clinical environment help alleviate the workload of qualified staff members (Sundler et al., 2014; Wildschut & Mgqolozana, 2009). This can have a two-fold effect on the learning of the MLS students: Students can gain real hands-on experience and translate theory into practice but it can also have negative implications in that students perform tasks that they may not yet be properly equipped to perform due to lack of adequate training (Unwin et al., 2005).

From the perspective of Zhao, Chen, Wang, Wu, Huang & Guo (2014) a benefit of integrating students into the workforce are that they work under conditions very similar to their future workplace which suitably prepares them for the environment where they will practice as qualified health care professionals.

Extensive research exploring the clinical experiences of healthcare students have been completed and evidence of the factors that enhance and inhibit clinical learning is vast in the literature (Dolmans et al., 2008; Lawal, Weaver, Bryan, & Lindo, 2016; Papastavrou et al., 2010; Papp, Markkanen, & von Bonsdorff, 2003) .Research performed during these studies have provided insight into student perceptions and experiences in the clinical environment and emphasized the link between healthcare students' learning experiences and the effect the environment has within which clinical teaching occurs. Against this background the research conducted aimed to identify the enabling factors and highlighted the barriers to learning during the practical period of MLS students. Recommendations to improve clinical learning in the laboratory context were proposed.

### **3. EXTENDED RESEARCH METHODOLOGY**

This section describes the research approach and details the methodology and design that was incorporated in the study. It also includes the ethical issues relating to the study and how the data was managed and analyzed. Academic rigor in terms of trustworthiness of the research is also discussed.

#### **3.1 Research design and methodology**

A research design refers to the strategies implemented in the research that integrate the underlying philosophical assumptions of the research, the selection of participants, the data collection methods and the data analysis that will be done i.e. the different components of the study to ensure that the research question is answered effectively (Maree et al., 2007; Yin, 2011).

A qualitative approach, guided by an interpretive paradigm and exploratory design was used in this study. Sim and Wright (2000) specified that in order to understand the conclusions that people draw from their situations in order to comprehend the particular context within which people interact are some of the purposes of qualitative data. According to Ritchie & Lewis (2003) qualitative researchers place emphasis on the interpretive aspects of the social interactions between humans that include the researcher's own understanding and interpretations of the phenomenon being studied. Mason (2002) denotes that an interpretive approach seeks the inside view to people's understanding and perceptions to a particular phenomenon. The researcher chose this strategy of inquiry as the intended purpose of the study aimed to explore the individual experiences of the MLS students during their fourth year clinical rotations in the laboratory.

#### **3.2 Population and sampling**

Silverman (2011) infers that obtaining workable data from the population being studied is an important intention of any research project. The author further argues that failure to gather data from a representative population will result in the research being one-sided and lacking any proof. A population in the context of this study is a group of individuals selected based on particular views, experiences and perceptions about a defined topic that the researcher wished to explore (Silverman, 2011; Sim & Wright, 2000).

The study population included students that were either enrolled in their fourth year of the BHSC: MLS degree in the process of completing their CPP or recent graduates that

completed the CPP within the private pathology laboratory setting during the two years that preceded the study. The researcher then further divided the study population into two cohorts of MLS students and graduates: Cohort one represented the group of MLS students that were in the process of completing their CPP at the time the study was conducted during 2016 and constituted nine participants. Cohort two constituted four graduates that already completed their CPP during the 2014-2015 periods. Table 3.1 gives a breakdown of the participant demographic including the gender of the participants:

**Table 3.1: Participant demographics**

Gender	Cohort 1	Cohort 2
Female	5	3
Male	4	1

Sampling refers to the selection process of a subset of the target population for the purpose of the intended study the researcher will conduct (Maree et al., 2007). Ritchie & Lewis (2003) and Silverman (2011) indicate that non-probability sampling is often used in qualitative research. In non-probability sampling the sample does not need to be statistically representative and not all members of the population has a chance of participating in the study. Cohort two (the 2014-2015 graduates) included foreign students from Zimbabwe that needed to return to their country of origin after the completion of their studies as well as graduates that accepted permanent jobs in other provinces throughout South Africa after qualifying. This left the researcher with only participants that were available in the Western Cape and all of them were invited to participate in the study, therefore making use of convenience sampling.

Convenience sampling is a non-probability sampling method where the study population is selected based on geographical proximity of participants or convenient accessibility to the researcher ( Etikan, Musa, & Alkassim, 2015). Maree et al. ( 2007) recommend that researchers may consider using convenience sampling where the population may be difficult to find, as was the instance with the MLS graduates.

### 3.3 Data collection methods

The process of data collection in qualitative research study is “directed towards the who, what and where of events and experiences” (Sandelowski, 2000, p. 338) The author further stipulates that focus groups are commonly used to generate data in qualitative studies because it allows the researcher to obtain a wide spectrum of information about events and situations in which he/she is interested. In this study focus-group interviews were conducted to generate data about the MLS students’ experiences in a private pathology laboratory setting and the data collection was completed between 10 and 31 October 2016 based on the availability of the participants. During the focus-group interviews discussions were directed among a small group of study participants in order to generate as many views, experiences and perceptions on a defined topic (Maree et al., 2007; Silverman, 2011). According to Yin (2011) interaction between members of the target population during focus groups is more beneficial than conducting individual interviews because group interactions may encourage participants to make observations brought about by the discussions that may not occur during individual interviews.

Sim and Wright (2000) suggest that a focus group should not be so large as to preclude adequate participation by most members but should not be so small that it fails to provide substantial data than that generated with individual interviews. Bearing this in mind the researcher divided the cohorts into small groups of four to five per focus-group interview. Cohort one that represented MLS students that were in the process of completing their CPP was divided into two focus groups of five (group one) and four (group two) students respectively. Cohort two was represented by the four graduates that completed their CPP during 2014 and 2015. The number of participants per cohort and focus group are summarised in table 3.3 below:

**Table 3.2: Summary of participants per cohort and focus group**

Cohort and Focus Group	Number of participants
Focus group 1: Cohort 1 (Group 1)	Five MLS students in the process of completing their CPP
Focus Group 2: Cohort 1 (Group 2)	Four MLS students in the process of completing their CPP
Focus Group 3:Cohort 2	Four MLS graduates that completed their CPP

To eliminate bias, the researcher in her capacity as clinical coordinator of the CPP chose not to conduct the interviews. A skilled mediator was utilized capture the data and to facilitate group interactions in order to deliver a broader understanding of what is being researched. A mediator is a person that has no direct link with the participants and who cannot unduly influence the outcome of the results (Silverman, 2011). She included all the members of the two cohorts to express their opinions but with minimum, if any, direction by using semi-structured questions (refer Addendum B). This was to done to get responses from participants to gain insight into their experiences during the CPP. Maree et al. (2007) suggest that semi-structured interviews outline the line of inquiry thereby guiding the interviewer to explore and probe new emerging lines of inquiry directly related to the phenomenon being studied. Each focus-group interview involved the same format and followed the same stages. An understanding of the stages of the interview process is helpful to offer insight into the appropriate strategies that must be applied to facilitate group discussions (Ritchie & Lewis, 2003). Below is an overview and short description of the format and stages that took place during the focus group interviews:

*Stage 1: Welcome and setting the scene for the interviews*

During this stage the mediator introduced herself and outlined the purpose of the study. She also indicated the roles and expectations of the participants and reiterated the importance of confidentiality.

*Stage 2: Individual introductions by participants*

During this stage the mediator switched on the recorder and asked each participant for a brief introduction and background. She also advised them about anonymity and that they should refer to themselves as male one, female two etc.

*Stage 3: Initiating discussions and introduction of the opening topics*

Following the introductions the mediator promoted discussions and tried to engage participant involvement by introducing the opening topic. She asked questions and generally enquired about the participant's views allowing time for thought and reflection on the questions posed.

*Stage 4: Facilitating discussions around the key points of the research*

During this stage the mediator asked participants to move from broad and general impressions to specific experiences. She facilitated active discussion amongst the participants, probing

further questions for clarification purposes whilst attempting to include everyone in the discussions.

#### *Stage 5: Ending the interviews and adjourning the participants*

This was the ‘winding down’ stage of the interview process where the mediator finalised the interviews by either allowing each participant an opportunity to express their final thoughts or by asking if there was anything else that they felt needed discussion. Finally the mediator thanked the group for their participation in the discussions, reiterated the purpose of the study and interviews, switched off the recorder and adjourned the group. (adapted from Ritchie & Lewis, 2003)

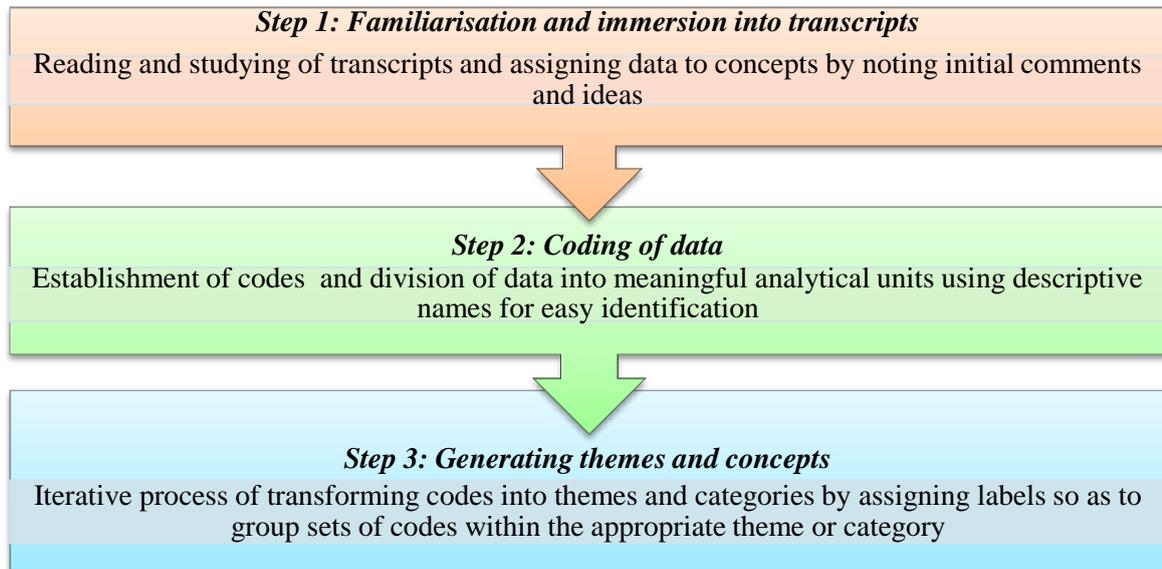
Once the interviews were concluded the recorded interviews were transcribed verbatim by a professional transcriber where texts from the interviews were typed into word-processing documents thus allowing for the data to be analyzed.

### **3.4 Data analysis**

Data analysis refers to the method in which the data was analyzed. Focus group analysis of data incorporated conventional techniques for qualitative data such as content, thematic, ethnographic or phenomenological analysis etc. (Silverman, 2011). An inductive thematic analysis was used in this study. In order to answer the research question the aim of analyzing the data was to develop “an organized, detailed, plausible and transparent account of the meaning of the data” (Larkin & Thompson, 2012, p. 104). Maree et al. (2007) and Henning, Van Rensburg and Smit (2008) suggest that the analysis of results must synthesize the results to corroborate themes or emerging theories to authenticate the participants’ experiences.

The researcher initially performed open coding to look for distinct concepts and categories in the data which formed the basic units of the analysis. This was an iterative process where the transcripts were analyzed and coded into themes through inductive content analysis by directly examining the data (Maree et al., 2007). An inductive approach is where the researcher begins with as few preconceptions about what he or she is studying as possible thus allowing significant themes to emerge from the raw data of the research findings (Maree et al., 2007; Thomas, 2006).

To present the analysis of the data in a more structured format a figure can be used (Larkin & Thompson, 2012; Ritchie & Lewis, 2003). See Figure 3.1 below.



**Figure 3.1: An illustrative overview of the data analysis process [Adapted from Ritchie & Lewis, 2003; Maree et al., 2007; Silverman, 2011; Larkin and Thompson, 2012]**

### 3.5 Ethical considerations

An application for ethical approval was submitted to the University of Stellenbosch's Health Research Ethics Committee 1 and 2 prior to conducting the study. Upon approval from the university's ethics committee (Ethics reference number S16/08/156) informed and voluntary consent was obtained in writing from the participants prior to conducting the interviews (Addendum C).

Obtaining consent implies that all possible information on the goal of the investigation was declared to participants. This included the procedures to be followed during the investigation, disclosing the advantages, disadvantages and any potential harm participants may be exposed to as well as the expected duration of the participant's involvement (De Vos, Strydom, Fouché, & Delpont, 2011). To ensure participants made voluntary and thoroughly reasoned decisions about their possible participation, all the participants were informed that participation in the study was completely voluntary; that they had the right to decline to partake in the study and that they could withdraw from the study at any point regardless of previous consent given.

All necessary measures were taken to ensure that confidentiality of the participants was maintained. Confidentiality implies that only the researcher and those involved in the investigation should know the identity of the participants and the information obtained during the study (De Vos et al., 2011). To this extent the researcher did not disclose any identifying information pertaining to the participants, recordings and the transcripts to anyone other than those directly involved in the study. Anonymity was maintained by denoting each participant a number and referring to them as such during recordings of the interviews for example male or female one, two, three etc. Once the recordings were transcribed and finalized, the recordings and the hard copies of the transcripts were locked in a filing cabinet and electronic copies were password encoded on the researcher's laptop. These will be deleted and discarded when no longer required.

### **3.6 Rigor and Trustworthiness of the research**

Rigor refers to the accuracy and thoroughness in collecting data (Mason, 2002; Yin, 2011). To ensure rigor in qualitative research the researcher must give a clear account of the methods and data collection/analysis used during the study and a plausible and coherent explanation of the phenomenon under examination (Yin, 2011). The concept of trustworthiness is used in qualitative research to ensure the quality and value of the final results and conclusions derived from the study (Schwandt, 2007). The criteria for trustworthiness used in this study included credibility, transferability, dependability, and conformability and will be discussed next including the way in which it was attained.

*Credibility* addressed the ability of the researcher to collect information accurately and consistently to provide assurances that will ensure that a similar study can be repeated (Schwandt, 2007; Silverman, 2011). To ensure credibility of the data, it was checked by the supervisors of the research assignment.

*Transferability* concerns the researcher's responsibility to ensure the generalization of the information gathered so that a degree of similarity can be established between the findings of the study which might be applied to another research study (De Vos, Strydom, Fouché, & Delpont, 2011; Schwandt, 2007). To ensure transferability of the study the researcher included thorough accounts of the information obtained from the participants so that other researchers can determine whether the findings can be applied to other research studies.

*Dependability* refers to the researcher's responsibility to ensure that the research process was rational, perceptible and documented (Schwandt, 2007). To ensure dependability the researcher consulted with experts in qualitative research (the supervisors) who participated in the data collection process and checked the analysis and interpretation of the data. She also monitored the process while writing up the research.

*Conformability* concerned the guarantee that the data was supported by literature and that there was an established link between the researcher's interpretation and evidence of the literature. Conformability was established by cross-checking and verification of the data detailing participants' responses and performing an extensive literature review on the pertinent aspects of the study findings.

### **3.7 Assumptions and limitations of the study**

A likely limitation of the study is that only students in the Western Cape were asked to participate due to the location of the researcher. The optimization of the fourth year will span across the national footprint of the organization and the views of students in other provinces would have added to the study. Another potential limitation of the study is that the focus was on the experiences of the students without exploring the views of other role players in the teaching of the MLS students, which are the training officers in the laboratory.

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## 5. THE RESEARCH ARTICLE

The research article was prepared for publication in the Elsevier Health Professions Education journal. Specifications and detailed author guidelines can be viewed in Addendum E.

### Abstract

*Purpose:* Medical Laboratory Sciences (MLS) recently introduced a new degree course for professionals of laboratory medicine. The revision of the qualification led to the re-evaluation and restructuring of the clinical practical period (CPP) by organizations that accommodate the students during their fourth year. The purpose of this study was to explore and describe the experiences of MLS students in a private pathology laboratory in the Western Cape, South Africa. An embedded aim of this research is the optimization of the clinical practice period in the fourth year of the programme.

*Method:* A qualitative approach, guided by an interpretive paradigm and exploratory design was used in this study. Three focus group interviews were conducted with students of medical laboratory sciences in the process of completing their degree, and recent graduates who have completed, their CPP. Semi-structured focus group interviews were conducted, recorded and the audio-recorded data was transcribed verbatim and coded through inductive data analysis to identify themes and subthemes.

*Results:* Three themes were derived from the data analysis which represents the factors that affected student learning during the clinical practice period namely ‘teaching-learning dynamics’, workplace dynamics and ‘suggestions for overall improvement’.

*Discussion:* The major findings of the research revealed that excessive workload due to perceived staff shortages in the various laboratories was the most significant contributing factors that affected the students’ learning. The benefit of peer assisted learning and interaction with positive role models of laboratory medicine was also highlighted.

*Conclusion:* The study produced evidence of both enablers and barriers to the learning of the MLS students during their clinical laboratory rotations. Improved preparation and exposure to the laboratory prior to the CPP might help to optimize the fourth year for future professionals of laboratory medicine.

**Keywords:** Clinical Practice Period; experiences; medical laboratory sciences; private pathology laboratory

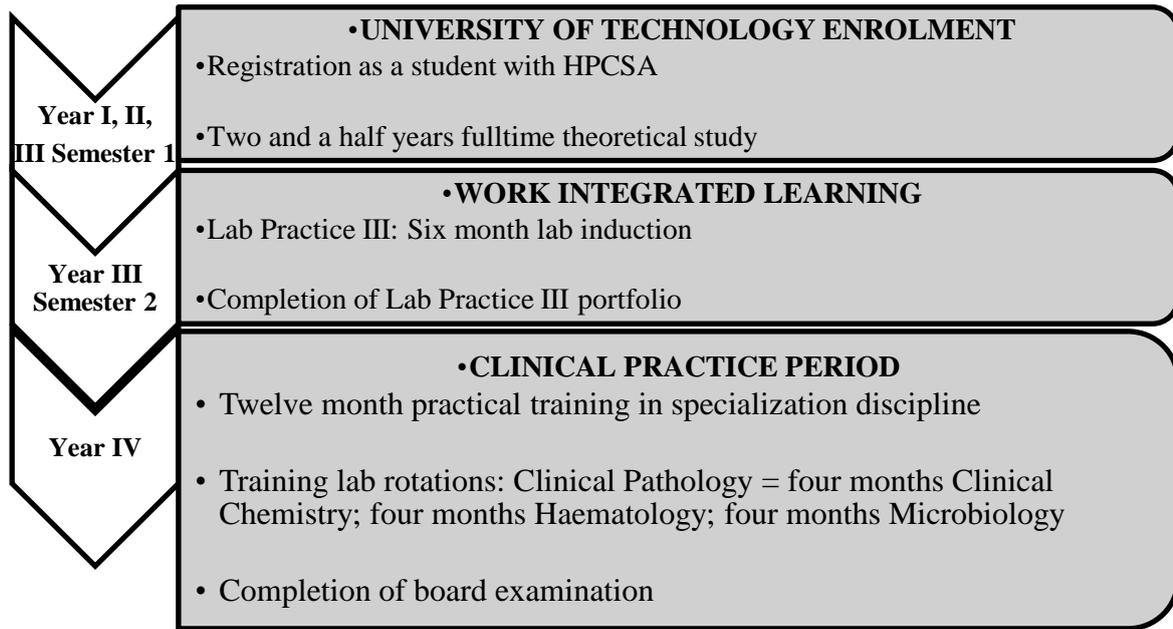
## 1. Introduction

The education of Medical Laboratory Sciences (MLS) students has undergone great changes in recent years with the introduction of the new Bachelor of Health Sciences in Medical Laboratory Sciences (BHSC: MLS) undergraduate degree. Medical Laboratory Sciences is a discipline of applied health sciences where the emphasis is mainly on the understanding, application and performance of clinical laboratory analyses in an accredited laboratory. This discipline of medicine is also referred to as Medical Technology and Clinical Laboratory Sciences. It encompasses laboratory personnel performing clinical laboratory tests, interpreting and reporting the results for the purpose of aiding the pathologist in diagnosis, treating and monitoring disease (Barcelo, 2016; Isabel, 2015).<sup>1,2</sup> Clinical Pathology is a specialization multidiscipline component of laboratory medicine, where students are required to develop academic and technical skills in three of the major areas of clinical laboratory practices: Clinical Chemistry, Haematology and Microbiology.<sup>3</sup>

The practical component of the BHSC: MLS qualification during the fourth year, known as the clinical practice period (CPP), is a collaborative process between the university and industry. Work based learning (WBL) is used to describe this period where MLS students are provided with opportunities to acquire the attributes required for their professional future.<sup>4,5</sup> During WBL emphasis is placed on industry's role to support and develop MLS students from both an educational and organizational perspective.<sup>4</sup>

The literature<sup>6,7</sup> describes clinical environments as 'classrooms' rich with planned, unplanned and incidental opportunities for inventive teaching and learning. In the context of laboratory sciences, the clinical laboratory is the real world learning environment where MLS students complete their clinical laboratory rotations. It is an environment where students are provided with opportunities to transfer theory to practice to acquire the knowledge, skills and attitudes required for their profession.<sup>2</sup>

During the CPP the MLS students rotate through various departments and different sites of laboratories which would expose them to various learning experiences and workplace cultures. The aim of clinical laboratory rotations is that MLS students work towards practicing independently and become competent practitioners of laboratory medicine through gradual decrease in direction and guidance from experienced and qualified medical technologists and technicians.<sup>8</sup> A schematic overview of the four year qualification in relation to Clinical Pathology is summarized in Figure 1 below:



**Figure 1: Schematic overview of four year BHSC: MLS undergraduate qualification**

Previous studies suggested that the experiences and perceptions of students of the clinical environment can greatly influence the degree and quality of learning that takes place during the clinical period.<sup>9-12</sup> Cognizance of the various factors of the workplace dynamics and the impact this multi-faceted environment had on student teaching and learning in the clinical laboratory needed to be explored. This study therefore focused on and addressed the core factors that affect the learning of MLS students during their practical rotations, namely the factors that enabled learning and those barriers that hindered learning in the clinical laboratory.

## 2. Methodology

A qualitative approach, guided by an interpretive paradigm and exploratory design was used in this study. The study population included students that were either enrolled in their fourth year of the BHSC: MLS degree in the process of completing their CPP or recent graduates that completed the CPP within the private pathology laboratory setting during the two years that preceded the study. The study population was subdivided into two cohorts of MLS students and graduates: Cohort one represented the group of MLS students that were in the process of completing their CPP at the time the study was conducted during 2016 and constituted nine participants. Cohort two constituted four graduates that already completed their CPP during the 2014-2015 periods. Convenience sampling was used based on

geographical proximity of participants and convenient accessibility to students that was available in the Western Cape at the time of the study.

In this study three focus-group interviews using semi-structured questions were conducted to generate data about the MLS students' experiences in a private pathology laboratory setting and the data collection was completed between 10 and 31 October 2016 based on the availability of the participants. Cohort one was divided into two focus groups of five (group one) and four (group two) students respectively and Cohort two was represented by the four graduates that completed their CPP during 2014 and 2015. Once the interviews were concluded the recorded interviews were transcribed verbatim by a professional transcriber where texts from the interviews were typed into word-processing documents thus allowing for the data to be analysed.

The transcripts were analysed and coded into themes through inductive content analysis by directly examining the data.<sup>13</sup> An inductive thematic analysis was used to analyse the data.

### **3. Results**

Thirteen MLS students specializing in Clinical Pathology participated in the study and these included both male and female participants in each of the focus group discussions. Three central themes emerged from the data generated from the semi-structured focus group interviews and are reflective of the factors that affected student learning in the laboratory. Based on the students' accounts of their experiences the themes that emerged were identified as: 'teaching-learning dynamics', 'workplace dynamics' and 'suggestions for overall improvement'. The following abbreviations are applicable to the various quotations from the interviews:

C = cohort; G = Group; F = female; M = male

For example C1F1G1 would refer to Cohort 1, Female participant 1, Group 1 or C2M6 would refer to Cohort 2, Male participant 6 etc.

#### **3.1 Theme 1: Teaching-Learning Dynamics**

This theme was characterised by descriptions that impacted student learning and the subthemes further identified implications for student teaching and learning in the clinical laboratory.

### **3.1.1 The effect of excessive workload from laboratory staff on student teaching and learning**

The most commonly expressed view was that excessive workload was a major contributing factor to the teaching and learning and/or their lack thereof of the MLS students.

*“Usually the training officers have their own work so they don't really have time to squeeze you in. So they will teach you something but it will just be so by the way” (C1F1G1)*

*“We are assigned a mentor, but they're usually so busy with their own work that they don't always contribute as much as they should.” (C1M5G2)*

Owing to increased workload pressures of staff and perceived staff shortages, the students expressed that they had to fill the role of worker which infringed on their time to learn in the laboratory:

*“... I think in most of the departments we were treated as workers. We didn't get much training; we just had to work most of the time.” (C1M2G1)*

*“The reason why they expect us to work is because most departments are understaffed. So they have work to do to finish in a certain amount of time so they expect us to step in and help with processing of samples and do things to get the work out and done so they don't spend much time on training.” (C1M1G1)*

It was evident that the students found the workload in the laboratories overwhelming and the realities of the private pathology laboratory setting daunting. Having to deal with the realities of what the profession entails is the essence of the practical period of medical laboratory sciences and thus good professional preparation.

### **3.1.2 Peer assisted learning**

The students expressed that the majority of their training involved peer on peer training, either involving them receiving training from a peer or giving training to a peer. The students' ascribed value to the experience of peer assisted learning and considered it a positive aspect to learning.

*“When we started there was like an older group of students so I learnt from them. So that's nice, the students helping each other because you learn a lot from them.”(C1F4G2)*

*“...because their experiences were a bit more. I think they were there a month or two before us and they already knew what to do in a way so they showed us. Then we showed the new ones that came in” (C1M2G1)*

One student however expressed the shortcoming of peer teaching:

*“I think it’s maybe just that you get along easier with a student. It’s easier to communicate and stuff with them but in the end of it, it is still a student. They don’t know the ins and outs of the lab. Ja, fair enough; I also learnt a lot when I was with the students because they were there a couple of months. So there was only a certain amount that they know as a student that they can give over to you whereas a permanent one can give almost twice the amount that they learnt what a student learnt. ” (C1M4G1)*

It seems that most students enjoyed the simultaneous teaching and learning dynamic among their peers. Although the students do not yet possess the same knowledge as experienced laboratory staff, they felt comfortable learning from someone who already learned the tasks and could explain it to them in a manner that they understood.

### **3.1.3 Role modelling in the clinical laboratory**

The students all expressed that they encountered at least one individual in the laboratory who impacted them positively and whose work ethic and behaviors they wanted to model.

*“I think probably in every department there was at least someone that you kind of looked up to and that, in my experience, was most of the time my mentor at that time that you kind of looked up to.” (C2F5)*

*“Some people are really passionate about their job. So I thought: Ok, I would really want to be like this also, I would really like to work like this also. You know what, they love what they are doing and they enjoy it.” (C2M6)*

A positive aspect of learning is the exposure of students to professionals of laboratory medicine who display behaviors and values that students wish to emulate. Conversely students may also encounter negative models in the workplace. However, if the students encountered any negative models they did not refer to them.

### 3.1.4 Personal and professional development

The students acknowledged that the teaching from laboratory staff and peers assisted in their own development of knowledge and skills. They considered it an enabling factor to their learning.

*“I think a good thing for me was to work with people, work under pressure and learn personal skills like telephone skills that you don't learn on campus.”(C1M3G1)*

*“There's a lot of things now that once I started working that made sense to me ; when I was in university I use to just usually study it parrot form, it didn't actually make sense to me, and when I came here and did it, it actually made a lot more sense. ” (C1F3G2)*

The ultimate aim of the CPP is to equip students with the necessary knowledge and skills required for the profession. This is not limited to only professional skills but also skills that will benefit to the students throughout their professional careers.

## 3.2 Theme 2: Workplace Dynamics

This theme emphasized the students' experiences in the workplace and the factors that impacted their learning during their rotations through the various laboratories. It was further subdivided into three subthemes. Some of these subthemes may overlap with the subthemes identified in theme one.

### 3.2.1 Student expectations of the fourth year and their function in the laboratory

It seemed from the students' communications that there was a mismatch between what they expected the fourth year to be and the realities of what they encountered once they started their rotations in the laboratory. All the students expected that diagnosing patients and consultation with the pathologist was going to be a significant component to their duties. They were however disappointed when they were expected to perform routine laboratory tasks.

*“We were told you are going to diagnose the patients and you going to get their results and you are going to call the doctor and tell them the patient has this and this. When you get to the lab you don't do that, you just process the specimen and give out results.” (C1F3G2)*

*“...when you come in the workplace you don't even give your input on what the patient will have to the doctor, so you just basically loading samples into a machine” (C2F7)*

It appears that the preconceived notions about the fourth years resulted in unrealistic expectations from the students. Even though the CPP is the period of extensive instruction of the tests contained in the syllabus, the students have had previous exposure to the laboratory during the 6 month inductive Work Integrated Learning (WIL) period. During this period they were exposed to the functions of the fourth year students in the workplace and the dynamics and realities of the laboratory, yet it does not seem if this had prepared them adequately for the CPP.

### **3.2.2 Access to learning resources in the laboratory**

Many of the participants reported the lack of access to learning resources as one of the inhibiting factors to their learning. Given the setting, students were not allowed to use their mobile phones when they are inside the laboratories.

*“We don't have access to the internet so we need to ask someone else to log onto the internet for us as well and you can't check on your phone on Google either because you can't have your phone in the lab, that's the problem.” (C1M5G2)*

Students were not given access to Standard operating procedures (SOPs) outlining various workplace protocols which are available via computer access. Although a few departments had hard copies printed, the students reported that they were dependent on staff for access to a computer.

*“SOPs are only assigned to the permanent staff so we have to actually ask the permanent staff to log onto their access or we have to ask the managers to allow us to get the SOPS” (C1F4G2)*

It appears that the students felt frustrated being dependent on the laboratory staff for the use of computers to access the learning resources they needed. By granting the students access to the SOPs and the use of computers the staff would alleviate the pressure on themselves by having to log the students in and also allow students to learn more independently.

### **3.2.3 Supervision of students in the laboratory**

There were mixed views when the students reported on supervision. The majority of the students verbalized that they expected continuous supervision. Lack of supervision caused distress on their behalf.

*“Students aren't always properly supervised. There needs to be someone who is watching what they are doing all the time to prevent the mistakes being made and I think that sometimes they are just left to do and they don't think of the consequences that that could have. So I think like proper supervision is really important. I felt that we were not properly supervised.” (C2F5)*

A small number of students however expressed that they considered working unsupervised as being capable to work alone.

*“... So by the time that you work unsupervised the bench supervisor is giving their permission that whatever you are doing is fine.” (C1MIG1)*

It was apparent that students considered supervision an important aspect to their learning. However, an intended aim of the CPP is that students will eventually have to work unsupervised so it was unrealistic that students expected constant supervision from the laboratory supervisors.

### **3.3 Theme 3: Suggestions for improvement of the CPP programme**

This theme focuses on suggestions from the participants on what they thought could improve the CPP future MLS students. To ensure that improved strategies are in place for quality clinical teaching and learning of medical laboratory scientists students the following recommendations were made by those that participated in the study.

#### **3.3.1 Student support**

The need for student support and one person with the specific role of student mentor was suggested by more than one participant. A further suggestion was that a specific day of the week is allocated to training of students with feedback on their progress as well as opportunities for students to discuss any concerns they may have as illustrated below:

*“I think it would be nice if they had a person whose specific job description would be just as a mentor for students, so that they don't have other responsibilities except the students” (C1F3G2)*

*“So maybe a Friday afternoon or Wednesday, have like allocated time for students and training or something like that so that you know before that time that you must do your work but then it's a set time that you have interaction with the students” (C1F2G1)*

### **3.3.2 Site allocation for training of MLS students**

Pathcare has a lot of smaller satellite laboratories across the Western Cape known as peripheral laboratories. Exposure to the peripheral laboratories was a further suggestion that was made so that students can experience other laboratory cultures as well as see the reference to how the knowledge and skills they acquired can be applied and utilized to capacity. The graduates that were placed at more than one site felt that the MLS students should be exposed to more than just the main laboratory where the other students were exclusively placed.

*“I definitely think that they should allow the fourth year students to go into the peripheral labs. I think that this degree is actually made for peripheral labs because your Clinpath degree gives you such a broad base of knowledge that when you're in the main lab you're just streamlined to one thing.” (C2F6)*

### **3.3.3 Integration of the three disciplines of Clinical Pathology**

Clinical Pathology as an elective discipline encompasses Clinical Chemistry, Haematology and Microbiology which are separate laboratories through which the students rotate. A further suggestion was the integration of the three disciplines of Clinical Pathology during the CPP. The students felt that they should be taught to see the relevance of pathological conditions across the three disciplines of Clinical Pathology and not experience them as three separate entities.

*“So in your final year you choose Clinpath for instance, so it's an integrated subject, which included three subjects basically. So I think maybe from the beginning of the entire course, your mind should be trained towards thinking integrately if that's the word.”(C1F4G2).*

*“I think do more integrated work, because especially in the peripheral lab you have to use Clinpath, so as a student learning all the background subjects I think it's vital to our thinking in the lab, especially in the Peripheral.” (C2F5)*

Some of the suggestions from the participants warrant further investigation and will be included in the further recommendations by the researcher.

#### 4. Discussion

In this study the individual experiences of the medical laboratory science students during their clinical laboratory placements revealed factors that were considered enablers to learning as well as barriers to learning.

Excessive workload of the laboratory staff and students being treated as workers due to perceived staff shortages was considered the major barrier to learning by all the participants. While the students expressed strong views on being treated as workers and thus not learning effectively, some researchers argue that performance of tasks by students translate into theory being converted into practice and therefore learning did take place.<sup>14,15</sup> In contrast to this, other literature has indicated that workload pressures and a shortage of staff have reduced the time for educating healthcare students thus reducing clinical learning opportunities.<sup>16</sup> This finding is in line with studies done to evaluate the staff workload in pathology laboratories<sup>17</sup> where students indicated that the main factor for their unhappiness with their training was the excessive workload of staff and a shortage of qualified staff. Excessive workload is especially prevalent in private settings such as the clinical laboratories, where productivity takes precedence to student training.

The findings of the study also revealed that students entered the fourth year with certain preconceived notions and expectations of what the CPP entails. The students had difficulty contextualizing and conceptualizing certain workplace methodologies because the theory covered at university was not aligned to what was needed for industry. They expected to play a bigger role in diagnosing patients which was a major component of their learning at university rather than just the processing of specimens in the laboratory. In laboratory medicine the key function of laboratory personnel is to aid the pathologist in diagnosing patients. Diagnosing patients is not in the scope of practice of laboratory professionals and is not a requirement for the profession. This indicated inconsistencies in the education of the MLS students and can probably be attributed to the curriculum being fragmented into separate theoretical and practical components and taught as separate entities. Thomas, Kern, Hughes & Chen (2016)<sup>18</sup> and Posner (2004)<sup>19</sup> suggest that aligning and integrating educational content is key to curricular development. Aligning and integrating both aspects of the curriculum is a strategy that should be reviewed to ensure adequate teaching of the MLS students.

The workplace based learning practices of the MLS students are supported by experiential theories developed by Kolb and rooted in adult learning.<sup>20-22</sup> Constructivism is the dominant philosophy of the institution where the MLS students received training as learning is seen as an active process that encourages students to take responsibility for their own learning.<sup>23,24</sup> Even though they had three years of preparation at university the students accepted little responsibility for their own learning and struggled to learn independently. Adequate practices during university that implement self-direction of learning should be considered to lessen the regulation of learning by the laboratories once the students enter the CPP.

Continuous supervision was an expectation that the students had of the fourth year due to their concern for any repercussions that may result if they made mistakes when processing real specimens of patients. Although a valid concern, and whilst supervision is an essential aspect of clinical learning<sup>6</sup>, an intended aim of any practical period is that students will eventually be expected to work unsupervised.<sup>8</sup> The need from the students to be directly observed for the duration of the CPP was unrealistic as the demands of the laboratory did not allow for continuous supervision by qualified staff. Additionally they already had three years theoretical training as a foundation for the CPP and was shown and observed by qualified staff on how to perform tasks prior to working unsupervised. They also had access to any qualified staff members in the laboratory to verify how to proceed with tasks or answer any questions they had.

The findings suggested that the students considered access to learning resources advantageous to their learning but that they were restricted by access to especially digital based learning resources. Even though the use of cell phones are prohibited in the laboratories, research studies relating to the use of technology in the clinical setting<sup>25,26</sup> have highlighted the benefits that digital learning resources provide. The benefit of handheld devices such as cell phones is that they are a convenient source of information and means of communication between students, educators and peers that can assist with learning. Embedding mobile technology in the teaching and learning strategies of the MLS students can alleviate the constraints of students being dependent on laboratory personnel for access to computers.

This study also highlighted the benefit of peer assisted learning during clinical laboratory learning. Peer assisted learning is an educational strategy that can assist students' learning during clinical practice. It encourages student interacting and learning from one another and

in the clinical environment to alleviate the capacity of staff training of students.<sup>27,28</sup> Promoting the use of peer assisted learning and encouraging students to be more involved in taking responsibility for their own learning during the CPP will alleviate the pressures of training from busy laboratory staff.

Another aspect that emerged from the findings was that the students appreciated the interaction with positive role models they encountered in the laboratory. Interactions with these individuals exposed the students to personal and professional conduct that they reportedly want to mimic during their own professional careers. This finding is in line with studies highlighting the powerful impact of role modelling<sup>29,30</sup> where the researchers concluded that both personal and professional behaviors that clinical instructors display are observed by students in the clinical environment.

While students reported an overall increase in their personal and professional development, Coll et al<sup>31</sup> acknowledge that learning during work-based learning can occur from a variety of sources and in variety of ways. These researchers demonstrated that exposure to various clinical teachers can enhance both the personal and professional abilities of students. The students see the benefit of clinical laboratory learning under the guidance of experienced laboratory staff where they were provided with opportunities to expand on their own knowledge and skills.

Further evaluation to better understand the educational effects in the context of current teaching and learning practices of the MLS students are imperative for future planning of the fourth year for the MLS students. The following recommendations for institutions involved in the teaching of MLS students are proposed for the optimization of the CPP pertaining specifically to the learning of the students.

- It is advised that industry-academia communications regarding the CPP should be improved specifically with relevance to student expectations and the realities of what the students will be expected to do during the fourth year.
- Review of current curricula should be considered and adjusted to give a more realistic view of the CPP. More exposure to the laboratory during the first three years of study to prepare students better for work-based learning should also be considered.
- Staff development for mentors and anyone who train students in the laboratory is also recommended. By providing short-term training in basic teaching skills, where the

principles of adult education are explained, the staff will be better prepared in how to approach training of the students.

- It is further recommended that a password encoded computer with SOPs and access to the internet is assigned to students during the laboratory rotations. This will be beneficial in alleviating the pressures of the busy laboratory staff and can empower and build confidence in students to act more independently.

## **5. Conclusion**

The CPP is crucial as a foundation for the professional future of the MLS students. Insights into the different experiences of the MLS students provided information to address challenges students face during the CPP and how current clinical laboratory experiences contributed to students' learning and readiness for practice. Suggestions for reviewing and restructuring of current practices from both industry and university perspective should be considered and implemented. Improved preparation and exposure to the laboratory prior to the fourth year practice period might help to optimize the CPP for future professionals of laboratory medicine.

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### **Disclosure**

Ethical approval was received from the University of Stellenbosch's Health Research Ethics Committee 2 (S16/08/156) on 27 September 2016.

### **Funding**

None

## **6. ADDENDA**

### **Addendum A: Excerpts from Clinical Pathology Fourth Year Syllabus**

# **CLINICAL PATHOLOGY MEDICAL TECHNOLOGISTS & MEDICAL LABORATORY SCIENTISTS**

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**SYLLABUS 4<sup>th</sup> YEAR INTERN MEDICAL TECHNOLOGISTS & MEDICAL LABORATORY SCIENTISTS  
CLINICAL PATHOLOGY**

## 6.0 CHEMICAL PATHOLOGY

### Objective

Provide in depth practical knowledge of the screening, quantitative and/or qualitative analytical processes used in the testing of specimens in Chemical Pathology and the clinical significance of the final results.

**Range:** Blood – timed and random; urine – timed and random; CSF; body fluids – transudates and exudates; aspirates; faeces.

### Specified outcomes

On completion of this section the intern should be able to:

- Demonstrate knowledge of the principles of the test methodologies in the range.

**Range:** Potentiometry; colorimetry; enzymatic/ kinetic; turbidimetry; nephelometry; enzyme immunoassay; chemiluminescence.

- Demonstrate knowledge of the individual principles of the manual and automated testing procedures used in the estimation of all the analytes in the range.
- Demonstrate knowledge of the limitation of the test methods, interfering substances and detection limits.
- Process samples in accordance with documented laboratory procedures.
- Utilize the correct units for reporting the results of the analytes.
- Describe appropriate physiological conditions affecting test results.
- Follow the correct procedures when handling critical/life threatening results.
- Demonstrate knowledge of the application of the normal reference ranges of all the tests in the range and ability to correlate laboratory results with physiological and pathological conditions.

### Range

#### **BLOOD**

##### *Renal*

- Sodium, potassium, chloride, tCO<sub>2</sub>, anion gap (calculated), urea, creatinine, uncorrected and corrected creatinine clearance, uric acid, pH, base excess.

##### *Lungs*

- pH, PCO<sub>2</sub>, PO<sub>2</sub>, TCO<sub>2</sub>, O<sub>2</sub> Sat. – Lung function tests. actual and standard bicarbonate and base excess.

## 7.0 MICROBIOLOGY

### Identification of organisms

#### Objective

Provide knowledge of the tests used in the differentiation and final identification of the listed organisms.

#### Specified outcomes

On completion of this section the intern should be able to:

- Describe in detail the methods, reagents and results obtained for the biochemical identification of the organisms listed.
- Accurately report on findings according to established laboratory protocols.
- Perform the appropriate tests for the identification of the organisms listed.

### Gram negative organisms

#### *a. Enterobacteriaceae:*

Enterobacter species

Escherichia coli

Klebsiella pneumoniae

Morganella morganii

Proteus mirabilis and Proteus vulgaris

Providencia rettgeri

Salmonella typhi

Salmonella species

Serratia species

Shigella, Shigella boydii, Shigella sonnei and Shigella dysenteriae

#### **Differentiation of above organisms by the use of the following tests:**

*Gram stain, colonial morphology on appropriate media, carbohydrate utilization (glucose, lactose), urea, indole, motility, H<sub>2</sub>S, citrate, decarboxylase, oxidase, ONPG.*

*A basic knowledge of the serotyping of Salmonella and Shigella.*

#### *b. Non-fermentative Gram Negative Bacilli*

*Acinetobacter baumannii*

*Pseudomonas aeruginosa*

#### **Differentiation of above organisms by the use of the following tests:**

Gram stain, colonial morphology on appropriate media, carbohydrate utilisation (glucose, lactose), motility, citrate, oxidase.

## 8.0 HAEMATOLOGY

### FULL BLOOD COUNT (FBC)

**Range:** Red cell count; white cell count; platelet count; neutrophils; lymphocytes; monocytes; eosinophils; basophils; haemoglobin; haematocrit; MCV; MCH; MCHC; RDW.

#### Specified outcomes

At the end of the training the intern should be able to:

- Process specimens with the use of an automated full blood count analyzer.
- Utilize the correct units for reporting the results of the parameters and cell lines.
- Demonstrate knowledge of the interpretation of the histograms and scatter plots generated by the auto-analyzer in use at the workplace.
- Describe the relevant changes in the FBC results which could be expected in the clinical conditions identified in this syllabus.
- Demonstrate knowledge of the reference ranges for all of the parameters and cell lines in the range.
- Follow the correct processes in the handling of critical/life threatening results.
- Correlate laboratory results with physiological and pathological conditions.

*Note:* In addition refer to section 4.0 Laboratory related mathematics.

### COAGULATION TESTS

**Range:** PT; INR; PTT; Fibrinogen; thrombin time; d-dimers; fibrin degradation products; cross linked degradation products; bleeding time.

#### Specified outcomes

At the end of this training the intern should be able to:

- Demonstrate a sound understanding of the haemostatic system.
- Describe and utilize manual and automated methodology for the determination of the tests in the range.
- Identify and apply the appropriate technical precautions in the testing process.
- Utilize the correct units for reporting the results of the tests.
- Demonstrate knowledge of the reference ranges for all tests in the range.
- Describe and follow the correct procedures in the event of critical/life threatening results.
- Demonstrate knowledge of the interpretation and clinical significance of the test results.

## **Addendum B: Data Collection Tools**

Semi –structured interview question for research project for **participants that are currently busy with their clinical practice period:**

1. What were your expectations upon entering the fourth year period at a private pathology laboratory? How did the reality compare to the expectation once you were in the workplace?
2. Was there a person/supervisor appointed to introduce you into the workplace and someone who can mentor you or who you can go to when you have questions? Is there anyone that stood out for you during your rotations so far in terms of mentoring or any of the technical staff that trained you?
3. Did you have any participation in decisions regarding your learning? Who decided what you will learn and when you will learn it? Did you take any initiative in contributing to own your learning or did you solely leave it to the discretion of the technologists and technicians who trained you?
4. What has been the highlight of your training so far? Can you share some of your most positive experiences up until now? Can you share some of the experiences that weren't so positive?
5. Did you receive feedback on your progress at the end of each stage of your training before you rotated to the next discipline? How was feedback provided?
6. You are now about three quarters through your practical training. If you could make any recommendations for the improvement of the training you received up until now, what would it be?
7. If you can give a rating out of 10 for your experiences of the clinical practice period thus far, what will it be? Why did you give it that score? (ask participants with different scores in the group).
8. Is there anything else anyone has to add or say as a final thought? About your experiences in general or anything specific?

Semi –structured interview question for research project for **participants that have completed the clinical practice period:**

1. Was there a person/supervisor appointed to introduce you to the workplace, staff and someone who can mentor you or who you can go to when you have questions during your period in the laboratory? Was there anyone that stood out for you during your rotations through the various labs?
2. What was the highlight of your training during the clinical practice period? Can you share some of your most positive experiences with me? What was the most negative experience during the CPP?
3. Did you receive continuous feedback on your progress during each stage of your training? How was feedback provided?
4. Did you have any participation in decisions regarding your learning? Who decided what you will learn and when you will learn it? Did you take any initiative in contributing to own your learning or did you solely leave it to the discretion of the technologists and technicians who trained you?
5. Were there sufficient opportunities for you to apply your theoretical knowledge to practice? Do you think you have developed both educationally and professionally at the end of the clinical practice period?
6. If you can give a rating out of 10 for overall experience of the clinical practice period, what will it be? Why did you give it that score? (Ask participants with different scores in the group).
7. What do you consider the strengths and the weaknesses of the program with regards to your learning? What are the areas of your training or the training program overall that you would improve upon? If you could make any recommendations for any improvement, what would they be?
8. Is there anything else anyone has to add or say as a final thought? About your experiences in general or anything specific?

## **Addendum C: Leaflet and Consent Form**

### **PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM**

**TITLE OF THE RESEARCH PROJECT:** Exploring medical laboratory scientist students' experiences during their fourth year clinical practice period: a qualitative study

**REFERENCE NUMBER:** S16/08/156

**PRINCIPAL INVESTIGATOR:** Liezel van Niekerk

**ADDRESS:** 262 Fourth Avenue,

Eikendal,

Kraaifontein

7570

**CONTACT NUMBER:** 073 300 5673

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

#### **What is this research study all about?**

I am conducting this study to establish the experiences of medical laboratory scientist students during their clinical practice period. I am trying to ascertain what the factors were that enabled learning and what the barriers were that prevented learning from taking place. The ultimate goal is to optimize the program for future students. Your participation in the study will help me to achieve that.

You will be asked to participate in focus group interviews. It will take approximately two hours of your time if you consent to participate in the study. The study will be conducted at the PathCare Academy in N1 City, Goodwood. This will be the only site the study will be conducted as that is where the study population is/were placed. There will be two cohorts who will be invited to participate in the study with an estimated total of 14 students; those that are

currently busy with their clinical practice period and those that already completed the programme. The students that voluntarily participate will be divided into groups of a maximum of five students per focus group.

**Why have you been invited to participate?**

Since you are currently busy with or have completed the clinical practice period, I feel that your input will be valuable to the intended study.

**What will your responsibilities be?**

All you will be required to do is participate in the focus group interviews and to relay your experiences during the clinical practice period.

**Will you benefit from taking part in this research?**

Since you have already completed the programme, or are almost near the end of the clinical practice period, you may not directly benefit from the study but your contribution will ensure that future students benefit from the research.

**Are there in risks involved in your taking part in this research?**

There are no perceived risks involved in your voluntary participation.

**If you do not agree to take part, what alternatives do you have?**

Not Applicable

**Who will have access to your medical records?**

Not Applicable

**What will happen in the unlikely event of some form injury occurring as a direct result of your taking part in this research study?**

Not Applicable

**Will you be paid to take part in this study and are there any costs involved?**

You will not be paid to take part in the study but refreshments will be served on the day of your participation in the focus group interview. There will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

You can contact the Health Research Ethics Committee at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by the investigator.

You will receive a copy of this information and consent form for your own records.

### Declaration by participant

By signing below, I ..... agree to take part in a research study entitled: *Exploring medical laboratory scientist students' experiences during their fourth year clinical practice period: an exploratory study*

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) ..... 2016.

.....  
**Signature of participant**

.....  
**Signature of witness**

### Declaration by investigator

I (*name*) LIEZEL VAN NIEKERK declares that:

- I explained the information in this document to .....
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (*If an interpreter is used then the interpreter must sign the declaration below.*)

Signed at (*place*) GOODWOOD on (*date*) ..... 2016.

.....  
**Signature of investigator**

.....  
**Signature of witness**

## Addendum D: Excepts From Transcripts of Focus-Group Interviews

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***M: Do you feel there is still enough learning or what is withholding you because then usually one can look at what is barriers preventing you from learning? Or then other enablers that makes it easier for you to learn? If you think in that way***

---

F 3: There's a lot of things now, that once I started working that made sense to me like if I go to Haematology and the stains I do on a bone marrow bench and the ABO blood grouping, when I was in university I use to just usually studied it parrot form, it didn't actually make sense to me, and when I came here and did it, it actually made a lot more sense. I can now give you the process of the Perl's Prussian Blue and it's not that much of a struggle and the principle. Whereas back then it didn't actually makes sense for me. So I think in terms of learning you do kind of learn things here and there.

F 4: But with Haematology and Micro I must say that being in the lab has helped a lot more than just getting the theory. But there are some things that being in the lab it doesn't teach you, so you don't learn really but then...

M 5: The thing is they put you immediately in the processing of specimens, they teach and you learn with regards to how the lab works.

---

***M: You obviously also work with people around you and you learn from them doing .Do you get assigned a mentor, or who do you learn from? Who looks after you when you've come in a new department now and you've got to do the things?***

---

M 1: Yes they give you people to help you.

M 2+ 3: Yes, they do.

M 3: Yes, they are assigned

M 5: We are assigned a mentor, but they're usually so busy with their own work that they don't always contribute as much as they should.

---

***M: And those people do they have other work to do as well? It's not there only job just to mentor?***

---

F 1: Usually they are the training officer. They have their own work so they don't really have time to squeeze you in. So they will teach you something but it will just be so by the way

F 2: Or they would refer you to a person on a certain bench that you are supposed to be with

F 4: I think it would be nice if they had a person whose specific job description would be just as a mentor for students. So that they don't have other responsibilities except the students

---

***M: Is there any people, the people who you are working with, do they give you regular feedback like you are doing this correctly, well done? Alternatively "I see you are not doing it right there" because that's the only way that you can go forward and know whether you know that area. Do you feel that's enough or is that formalised, how does that happen?***

---

F 2: Feedback when something goes wrong. When you processed the sample incorrectly then they will be like "ok guys, we know you are students". For instance there was this incident whereby they knew the students were not sending samples to Haematology. Fluids that we were processing and were supposed them for a cell count to Haematology. Some of the students were not. Haematology would come back to us asking "why are you not sending fluids?" Eventually it went to the manager and only then were the students aware that after processing a synovial fluid or there are a number of fluids that were allocated for that. You should send it to Haematology. So maybe that's another form of feedback we get when something goes a bit incorrect and then you're like "oh I didn't know I was supposed to do that" and then you take it from there.

F 3: I'd say ok, for instance when processing a specimen and you're plating out a swab on the wrong plate; in that regard someone will come to you and say "no you process the swab on this certain plate because this and that won't happen. Maybe you should try that plate. In that regard yes then it happens

F 4: But that's only when they are present while you're doing it. They won't maybe like a day later or maybe two weeks later talk to you and say ok you've been doing this well or that wrong. It's just they happen to be there when you did it wrong.

M 2: I think in Microbiology each bench has its own permanent staff member so they have to oversee that whatever you are doing is accurate and fine. So by the time that you work unsupervised the bench supervisor is giving their permission that whatever you are doing is.

---

***M: Is there no assessment in that time when you're working the clinical area?***

---

M 3: There is.

F 1: Proficiency tests...

F 2: We do have proficiency tests towards the end of the four months...

M 1: But not in all departments

---

***M: So there's no formal test to say that you've passed at the end of that?***

---

M 1: In the sense of our practical training there is no formal assessment to say this student passed or you fail on some aspects of the training or what. If you don't know something, you just move on. It's not necessarily that you fail it or whatever, it's just...

M 2: I think in our file that we have competent or not competent...

But towards the end they don't...because you've been performers they are not going to remember that for the whole four months we did this. They will just say we did that and then tick competent; we did that and they tick competent.

F 2: Not if they give it to you are competent, as long as you passed through it, they tick competent

F 5: Didn't they write in our books?

F 7: There was.

F 5: That was the only, because you might have not spend a lot of time with that person, but then they have to grade you at the end of the day. That wouldn't make sense, like the manager who is in the office all day would grade you on the stuff that you did, but they weren't even there.

---

***M: It's almost like attendance?***

---

All: Yes

F 1: It's not really monitoring you it's just "ok, you were here"

---

***M: Ok but prior to that then watching you and seeing that you are doing it correctly so that you can become unsupervised, do they give you feedback?***

---

M 2: Most of the time they after they, let's say do teaching on this bench now, then now they watch you process and say you now process four specimens, they see you're doing fine then they'll say ok you can process that next batch on your own.

M 1: In Micro they gave us the proficiency test when we started there. So they gave us time to work through it just to get to know the lab more

M 2: Then we only got the feedback much later in that time period when we were in that department

M 1: Yes

F 6: I don't think in the lab there is feedback.

---

***M: Would it help you if you get more feedback? Do you know where you at? Do you know whether you are on par?***

---

F 2: I think it will help if they tell us during the months while you're there because then you can also know where and what's my strong point, what's my weak point. Because to tell you at the end, you need to go to a new department so you can't really improve on that area that they found you have a weakness there.

---

***M: But how do you think you will learn best or is it ok for you to just struggle on your own? If you can put recommendations forward (and how) and we know the system is quite burdened, there are not a lot of people, but within that context how do you think the students can be supported?***

---

M 4 (sighs): I feel, well for me the best way a student can be supported is to have someone who understand the majority of what is going on in that specific area of the lab and let the

student do the work. If they make a mistake let them make the mistake or guide them while doing the mistake, at least they know what they are doing wrong. In order to do something right you need to know what to you do wrong. So, like, allow them to make the mistake so they can learn from it and they can guide us through it. For me, when I was in Micro I also made a couple of mistakes but nobody rectified me when I was doing it, so the next then they came to me and almost bit my head off and asked why did you this. And I told them but nobody was there to help me. And I asked for help and they said they were busy so I couldn't just let the samples stand there. So for me personally I think at least have one person there just to look out for what you're doing as a supervisor or just guide you or help you when you need help otherwise...ja.

---

***M: Do you have any resources to refer back to? Like the case that you're referring to right now clearly shows that you are not very sure you are doing it correctly. So is there a resource you can go back to, apart from people? That you can go and make sure that I am doing the right thing?***

F 4: Mostly the managers in their offices have text books if you want to look up something

---

***M: A textbook will be difficult if you want to look something up in a hurry***

---

F 2: We usually read SOPs

M 2: Yes. Speaking about SOPs: Only the permanent staff has access to the SOPs because it's on the system. And only one or two departments have hard copies of certain tests. So if we get stuck we can't access the SOP

M 5: Also, the access that we have to the internet, we don't have it so we need to ask someone else to log onto the internet for us as well and you can't check on your phone on Google either because you can't have your phone...

---

***M: Do you think it would've helped you if you have access to the SOP?***

---

All: Yes

F 2: I t would have helped a lot

---

***M: You've worked in various laboratories now, if you think just generally were there anybody anywhere that stood out to you, like a role model, like a mentor, somebody you at that time thought "I'd like to become like that one". Can you, you don't have to name that person, it's not about names, it's about did you come across such a person in your training? Even now after your training (silence)...anybody that remembers something?***

---

F 5: I think you've come across a few people if you go or might perhaps, probably in every department there was at least someone that you kind of looked up to and that's kind of, in my experience it was most of the time my mentor at that time that you kind of looked up to.

---

***M: OK. So if I can just also clarify you said look up to maybe let's just define that a bit with regards to which components of the work or personal attributes. What would you say that that person influenced, because at that time you were younger, you were more a learner.***

---

F 6: Probably their work ethic.

F 5: Yes. Work ethic and also like leadership skills as well. So like work and probably more of a personality aspect as well. Their willingness to help you and show you things...Because a lot of times sometimes you can go to a department and people will look at you as a student and go like "Agh here comes this student" but then you also get one or two that really want to engage with you, show you new things. And that is the person that you'll be drawn to.

M 6: When you say there is some people are really passionate about their job. They really like what they are doing; they're not in for the money or for the work. They just really enjoy it. You'll find some/a few of those people out there also.

F 7: Uhm, in my work place as well there is a lady there, probably it's the experience that she always tells you that they used to do "this and that", the point is the more experienced the person is the more they know something and then the more you can learn from them.

---

***M: And now that you qualified, do you think some of those barriers have been broken down, or is it still there?***

---

F 5: I feel like they know we are doing the same thing so I feel like there's that much of a...I don't know...

F 7: But you do get comments like "but you're supposed to know, you're a medical scientist and I'm just a technologist"

F 6: ...even in my workplace they are like "just ask the scientist; she'll know" (laughs). She ought to. But they're just joking maybe.

M 6: Yes. Especially I'm at PCP and I get them sometimes. Sometimes I just feel that they joking or they're not serious or something, but I also get those comment "you're a scientist you should know this" if I ask some silly question that I forgot, something that I did before but I need a reminder... some will be like "you're a scientist you don't know this ?". Once in a while but not that often

F 5: Even as a student you got those and it's like we should know.



## Addendum E: Author Guidelines

### GUIDE FOR AUTHORS

#### PREPARING A MANUSCRIPT: INSTRUCTIONS FOR AUTHORS

Below you will find a fairly detailed description of how a paper to be submitted to Health Professions Education should look like. Attached to this document you will find a Sample Manuscript visualizing the look and feel of a manuscript to be submitted, with references to the formatting requirements detailed below.

##### 1. General Format

1. All manuscripts can only be submitted electronically via Editorial Manager.
2. Manuscripts should be double-spaced and left-justified (this includes references).
3. Use consistently either British English or American English.
4. Use 12-point font size, Times New Roman.
5. Use 2.5 cm margins, and format for A4 paper.
6. Number all pages, starting with the title page.
7. Spell out all acronyms in full at first use.
8. Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to "the text". Any subsection may be given a brief heading. Each heading should appear on its own separate line.
9. Make headings as short as is feasible. Use a maximum of four-level headings.
10. Level 1: Centred, Boldface, Uppercase and Lowercase Headings; Level 2: Left-aligned, Boldface, Uppercase and Lowercase Heading; Level 3: Indented, boldface, lowercase heading with a period. Begin body text after the period; and Level 4: Indented, boldface, italicized, lowercase heading with a period. Begin body text after the period.
11. Follow internationally accepted rules and conventions: use the international system of units (SI). If other quantities are mentioned, give their equivalent in SI. Authors wishing to present a table of nomenclature should do so on the second page of their manuscript.
12. Present simple formulae in the line of normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

##### 2. Before main text

###### A. Title page

1. The first page of the manuscript is a title page containing the following information:
2. The manuscript's full title. Centred, Boldface, Uppercase and Lowercase. The title must be concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible;
3. An author byline that lists all authors' full names and affiliations. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation below the names.
4. One-sentence bios for each author (page 2 of the title page); list position(s) or title(s) and institutional affiliation(s);
5. Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Contact details must be kept up to date by the corresponding author; and

6. Disclosures section. All articles published in Health Professions Education must include a structured disclosures section as part of the title page (page 2 of the title page). Each category should appear as a separate paragraph: **Ethical approval:** For manuscripts involving studies with human participants, either (1) state that ethical approval has been granted (or waived) and include the date and reference number; or (2) indicate "Not applicable." **Funding:** List any external funding, including grant names or numbers, or indicate "None." **Other disclosures:** List any potential conflicts of interests.

###### B. Abstract

1. The abstract appears on its own page, between the title page and the first page of the main text of the manuscript.
2. The abstract should be written in the past tense and in third person.
3. The maximum length of the abstract is 300 words.
4. The abstract must fully represent the scope of the manuscript and it cannot contain information that is not included in the main text as well.
5. Data and findings reported in the abstract must match those reported in the main text of the manuscript.
6. For research reports: abstracts must be structured as follows: (1) Purpose, (2) Method, (3) Results, and (4) Discussion.
7. For innovation reports: abstracts must be structured as follows: (1) Problem, (2) Approach, (3) Outcomes, (4) Next Steps.

###### C. Keywords

Authors are invited to submit keywords associated with their paper (max. 5). Place keywords in alphabetical order and separate with semicolon.

###### D. Abbreviations

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

##### 3. Main text

The following structure for the main text applies depending on the type of report. For research reports. Structure the body of the manuscript using the main headings (1) Introduction, (2) Method, (3) Results, and (4) Discussion OR (1) Introduction, (2) Method, (3) Results and Discussion, and (4) General Discussion. For articles. Create headings that are to the point and that will give readers a sense of the article's organization. For innovation reports. Structure the body of the manuscript using the main-level headings (1) Problem, (2) Approach, (3) Outcomes, and (4) Next Steps.

###### A. Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

###### B. Methods

Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described.

*Software used:* When describing statistical analyses in the Method section, the name and version of the software used must be stated and referenced.

###### C. Results

Results should be clear and concise. Use two decimal places for mean values. Report appropriate confidence intervals whenever possible. Report standard deviations in parentheses (mean (SD)).

Report actual  $P$  values to two decimal places (e.g.,  $P = .01$ ), unless  $P < .01$  or rounding to two places would make a particular value non-significant. In such cases, report the  $P$  value to three decimal places. Report effect-size with  $P$  value.

#### A. Discussion

This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature. The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

### 3. After main text

#### A. Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

#### B. Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

#### C. Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article, using superscript Arabic numbers. Many word processors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list. If footnotes are used in a table, indicate each footnote in a table with a superscript lowercase letter.

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You are urged to visit this site; some excerpts from the detailed information are given here.

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Figures should be two-dimensional; black-and-white or grey scale; and without gridlines or background shading. Both axes (if applicable) must be labelled. Ensure that each figure has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used. A caption should make the figure sufficiently understandable independent of the manuscript text. All figures must be called out in the text and the position should be indicated in the text as “Place Figure about here.”

Note: Health Professions Education does not redraw or create figures. It is the author’s responsibility to provide high quality figures that are ready to publish and to make revisions as requested by staff editors during the review and editing processes.

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Use tables only (1) when information cannot easily be stated or summarized in the manuscript itself, and (2) when that information is of central concern (e.g. enables replication or verification of findings). Be sparing in the use of tables and ensure that the data presented in tables do not duplicate results described elsewhere in the article. Up to 5 tables are permitted unless the editor-in-chief agrees to deviate from this guideline. Tables must be created in Word using the table function. Tables created in Excel or informally created in Word with tabbing or spacing is not accepted. Table titles should make the table sufficiently understandable independent of the manuscript text. Typically, include type of data, number and type of respondents, place of study, year of study. Titles should be placed directly above the table. Columns should be clearly labelled and include unit of measurement. Number tables consecutively in accordance with their appearance in the text. Place footnotes to tables below the table body and indicate them with superscript lowercase letters. Avoid vertical rules. All tables must be called out in the text and the position should be indicated in the text as “Place Table about here.”

### 4. References

#### A. Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include

a substitution of the publication date with either “Unpublished results” or “Personal communication” Citation of a reference as “in press” implies that the item has been accepted for publication.

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As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

#### B. References in a special issue

Please ensure that the words ‘this issue’ are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

#### C. Reference style

Authors are responsible for the accuracy and completeness of their references. The reference style of Health Professions Education mirrors the American Medical Association (AMA) style. (See: <http://www.amamanualofstyle.com/view/10.1093/jama/9780195176339.001.0001/med-9780195176339>). The list of references should be double-spaced and placed at the end of the manuscript. Number the references according to the order in which they are first cited in the manuscript (do not list alphabetically). Use superscript numerals in the body of the text to indicate the reference list numbers being cited.

#### D. Examples

Reference to a journal publication:

1. Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. *J Sci Commun*. 2000;163:51–59.

Reference to a book:

2. Strunk W Jr, White EB. *The Elements of Style*. 3rd ed. New York, NY: Macmillan; 1979.

Reference to a chapter in an edited book:

3. Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, eds. *Introduction to the Electronic Age*. New York, NY: E- Publishing Inc; 1999:281–304.

#### E. Journal abbreviations source

Journal names should be abbreviated according to Index Medicus journal abbreviations: <http://www.nlm.nih.gov/tsd/serials/lji.html>; List of title word abbreviations: <http://www.issn.org/2-22661-LTWA-online.php>; CAS (Chemical Abstracts Service): <http://www.cas.org/sent.html>. General note: If Health Professions Education invites a revision of or accepts a manuscript prepared according to the requirements, the author must then revise the manuscript to meet Health Professions Education’s specific requirements (e.g., reference style) as directed by a staff editor.

#### Submission checklist

The following list will be useful during the final checking of an article prior to sending it to the journal for review. Please consult this Guide for Authors for further details of any item.

Ensure that the following items are present:

One Author designated as corresponding Author:

- ✓ E-mail address
- ✓ Full postal address
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- ✓ All necessary files have been uploaded
- ✓ Keywords
- ✓ All figure captions
- ✓ All tables (including title, description, footnotes)
- ✓ Further considerations
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