ROLE OF WORKPLACE BASED ASSESSMENT OF RADIOGRAPHERS IN INFORMING CURRICULUM DEVELOPMENT PRACTICES: A PLAIN X-RAY FILM TECHNICAL SUFFICIENCY EXEMPLAR USING 2010POST-REGISTRATION RADIOGRAPHERS

By

James Maimbo Sichone

A Thesis Submitted to the University of Zambia partial in fulfilment of the requirement for the Degree of Doctor of Philosophy in Health Professions Education

The University of Zambia

School of Medicine

Lusaka

2020

DEDICATION

This thesis is dedicated to my family, who inspire and love me. To my late parents, Musyani and Nellers Sichone whom I wish could be around today to see their efforts come to fruition. To the love of my life, Phanny, who has sacrificed so much to see me get this far. To the three girls in my life, Nkumbu, Lusubilo. and Lukundo. You girls remind me of how truly blessed I am.

COPYRIGHT

I hereby declare that a copy of this thesis is deposited on provision that anyone who consults it, is obliged to note that the author of this thesis has the copyright of the thesis. Therefore, prior consent should be sought from the author to publish any part of it either from its hard binding or soft copy and any material sourced from it must be referenced to the source accordingly.

© James Maimbo Sichone 2020. All rights reserved.

DECLARATION

I **James Maimbo Sichone** declare that this thesis is my own, unaided work. The various sources used have been referenced. This thesis is being submitted for the Doctor of Philosophy degree at the University of Zambia. It has not been submitted before for any degree or examination in any other university.

Signed …………………………………. Date…………………………………..

Supervisor

Prof. Sekelani. S. Banda **MB ChB, MSc, MMEd, PhD, FAcadMEd (UK)**
Deputy Vice Chancellor
Levy Mwanawasa Medical University
Great East Road
Lusaka
Zambia

Signed …………………………………. Date…………………………………..

APPROVAL

This PhD by **James Maimbo Sichone is approved** in fulfilment of the requirements for the award of Degree of Doctor of Philosophy in Health Professions Education by the University of Zambia.

…………………………	………………………	…………………………
Internal Examiner 1	Signature	Date
…………………………	………………………	…………………………
Internal Examiner 2	Signature	Date
…………………………	………………………	…………………………
Internal Examiner 3	Signature	Date
…………………………	…………………	…………………………..
Chairperson Board of Examiners	Signature	Date
…………………………	…………………	…………………………..
Supervisor	Signature	Date

ABSTRACT

It has been established that a curriculum requires periodic reviews to ensure concordance with contemporary demands for training. Erratic review of the diploma radiography curriculum presents a probable risk that a curriculum and workplace requirement mismatch may exist for radiographers trained in Zambia. The inconsistent review is set against a background where rapid technological and professional developments have occurred. Such a mismatch can bring about doubts in the fitness for the practice of these radiographers, which may culminant in poor patient management outcomes due to misdiagnosis resulting from poor radiography services. To establish concordance between curriculum output and clinical practice requirement, curriculum developers need to take into consideration the performance of graduates of such curriculum. However, an actual assessment of the graduates in a clinical setting post qualification is not routinely undertaken.

The question set out to be answered centred on how Work-placed based Assessment (WBA) can be used to improve radiography curriculum development practices. The main objective was to analyse the extent to which radiographers who graduated after 2010 are meeting the job requirements and to evaluate their competency levels in plain x-ray technical sufficiency assessment using a cross-sectional study design.

A sequential explanatory mixed-method design was used. The process utilised a multistage approach with each phase seeking to answer a specific research question. The qualitative stage had two phases which sought to obtain consensus on the job role/competence of a Zambia radiographer. This first aspect of the study utilised a Delphi approach and focus group discussions (FGDs). The quantitative stage used information from the earlier phases. A cross-sectional design was employed in this stage of the study. Assessment of competency was based on technical evaluation of five (5) chest X-rays for anatomical coverage, patient positioning, exposure, contrast, sharpness, image annotation and radiation protection. A total of 31 participants participated in the self-assessment and WBA conducted in four teaching hospitals. The last phase was a desk review which utilised the output from the first three phases to evaluate the 2004 radiography curriculum.

The initial two phases resulted in the identification of eight (8) competence categories for the Zambian radiographers. There was a significant variation with regard to the self-assessment across the different assessment categories ($p<0.0001$) with significance set at 0.05. In terms of aggregated self-assessment scores, the mean score out of 35 was 26.77 (SD 4.18). In the WBA, only eight (8) (26%) of the participants were assessed as competent. A regression model revealed that sex and rating of self-perception were the only predictor variables of overall competence. Review of the curriculum showed that objectives dedicated to image quality were less than 3% of the total learning outcomes.

The study was able to demonstrate that WBA can be a useful tool in generating information that can help to guide curriculum development and review practices for the radiography training in Zambia. Furthermore, the 2004 TEVETA diploma radiography curriculum was deficient in outcome specifications that relate to technical competency. Having a curriculum that responds to societal requirements make graduates of such programmes more suitable for contemporary practice and hence better delivery of medical imaging services in Zambia. Further interrogation of other training factors associated with reduced competence levels is required to improve outputs of radiography training programmes. The curriculum review

process, as conducted by TEVETA, can be strengthened by assessment of already qualified radiographers. A model has been proposed to enhance the curriculum review process. This has been termed ‘Three pillar information gathering framework for curriculum evaluation’. It is recommended that this framework should be integrated into the process of curriculum review in radiography training.

Key Words: Competence, Curriculum, Curriculum Development, Radiography, Workplace based Assessment.

ACKNOWLEDGEMENT

The PhD journey is one that requires an individual to carry the burden of delivering an academic milestone that should contribute to the body of knowledge in a meaningful way. Such a duty is impossible to bear alone. Several individuals made the burden lighter by their support.

My gratitude goes to Prof. S.S Banda; your demand for five-star quality work was a significant driving force during this journey. It was a pleasure to work with you. Your sincerity, coupled with your intellect, is an unusual combination. I would not have achieved this without your help, thank you.

Special thanks to Dr Marimo, Dr S. Nzala, Dr P. Kaonga, Dr G. Chongwe, Dr L. Banda, Dr D, Sitali, and Dr M Nawa for providing insight and encouragement.

I am grateful to the Department of Medical Education Development in the School of Medicine at the University of Zambia. The DMED Gang; Michael Chigunta and Aubrey Kalungia, You have been the best partners on the journey.

My sincere thanks also go to the participants who were willing to participate in this study without making demands.

TABLE OF CONTENTS

DEDICATION I
COPYRIGHT II
DECLARATION III
APPROVAL IV
ABSTRACT V
ACKNOWLEDGEMENT VII
LIST OF TABLES XIII
LIST OF FIGURES XIV
ABBREVIATIONS AND ACRONYMS XVI
DEFINITIONS IN TERMS XVIII

Chapter 1 INTRODUCTION 1

1.1 Introduction 1
1.2 Background 2
1.3 Problem statement 3
1.4 Study purpose 4
1.5 Significance 6
1.6 Research questions 7
1.6.1 Main research question 7
1.6.2 Specific questions 7
1.7 Research aim and objectives 7
1.7.1 Main research objective 8
1.7.2 Specific Objectives 8
1.8 Rationale 8
1.9 Key findings and implications for theory and practice 10
1.10 Outline of the thesis 11
1.11 Conclusion 13

Chapter 2 LITERATURE REVIEW 14

2.1 Introduction 14
2.2 Curriculum design, development, implementation and evaluation 17
2.2.1 Theories underpinning curriculum development 17
2.2.2 Instructional design process 20
2.2.3 Evaluation of educational interventions 22

2.2.4 Curriculum evaluation *23*

2.2.5 Curriculum analysis *24*

2.4 Workplace based Assessment 24

2.4.1 Validity and Reliability of WBA *27*

2.5 Competency in radiography 27

2.5.1 Assessment of overall radiographer competencies *28*

2.5.2 Assessment of radiographers' specific technical competencies *29*

2.5.3 Plain X-ray film image quality *30*

2.7 Radiography training in Zambia 32

2.8 Radiography practice in the Zambian health care system 33

2.9 Conceptual framework 34

2.9.1 Training factors *34*

2.9.2 Legal and professional factors *36*

2.9.3 Changing trends for radiography practice *36*

2.9.4 Role of curriculum review in improving outcomes *37*

2.10 Summary of findings from other research studies 37

2.10.1 Usefulness and acceptability of WBA *38*

2.10.2 Use of contemporary information to guide curriculum development *38*

2.11 Conclusion 39

Chapter 3 METHODOLOGY 41

3.1 Introduction 41

3.2 Conceptual framework Linkage 42

3.3 Research paradigm 42

3.4 Overall research design 43

3.5 Description of Phase I 44

3.5.1 Phase I Study setting *46*

3.5.3 Data collection for phase 1 .... *47*

3.5.4 Data analysis for Phase 1 .... *48*

3.5.5 Trustworthiness *49*

3.6 Description of phase II 49

3.6.1 Study setting *50*

3.6.2 Population and sampling for Phase II *50*

3.6.3 Phase II data collection *52*

3.6.4 Data analysis for Phase 1I *52*

3.6.6 Trustworthiness *53*

3.7 Description of phase III 54

3.7.1 Study setting for phase III *54*

3.7.2 Population Phase III *55*

3.7.3 Data collection Phase III..*55*

3.7.4 Data analysis..*62*

3.7.5 Validity and reliability *63*

3.8 Description of phase IV 63

3.9 Ethical issues 63

3.10 Conclusion 64

Chapter 4 PRESENTATION OF FINDINGS 65

4.1 Introduction 65

4.2 Self assessed competence and Work-based assessment 65

4.2.1 Participant demographics and clinical experience..*66*

4.2.2 Results for the self-assessment..*68*

4.2.3 Work-based assessment results..*70*

4.3 Development of job Competency list 87

4.3.1 Participant attributes..*87*

4.3.2 Round 1 Delphi..*89*

4.3.3 Round 2 ....*91*

4.4 Consensus on radiographer competences and global rating of performance 99

4.4.1 Attributes of FGD participants *100*

4.4.2 Findings from FGD *101*

4.5 Phase 4 results..116

4.6 Conclusion 118

Chapter 5 DISCUSSION 119

5.1 Introduction 119

5.1 Demographic characteristics of the participants 120

5.2 Evaluation of technical competence of radiographers 121

5.2.1 Workplace Based Assessment..*121*

5.2.2 Rating of radiographer performance..*128*

5.3 Consensus on radiographer competencies 129

5.3.1 Overall job description of radiographer..*129*

5.3.2 Consensuses on job roles and competencies *131*

5.4 Curriculum evaluation 138

5.5 CONCLUSION 140

Chapter 6 CONCLUSION AND RECOMMENDATIONS 141

6.1 INTRODUCTION 141

6.2 MAJOR FINDINGS...142

6.2.1 WBA summary findings...142

6.2.2 Self-assessed (perceived) competence summary findings 142

6.2.3 Summary of contemporary competencies 143

6.2.4 Curriculum evaluation summary findings 144

6.2.5 Overall finding 144

6.3 IMPLICATION OF THE FINDINGS 145

6.3.1 Radiography practice...145

6.3.2 Curriculum developers 145

6.4 PROPOSED FRAMEWORK FOR CURRICULUM REVIEW..146

6.4.1 Three pillar information gathering framework for curriculum evaluation *...............................146*

6.4.1.2 Training programme evaluation 148

6.5 FUTURE RESEARCH OPPORTUNITIES 149

6.6 RECOMMENDATIONS..150

6.6.1 Radiography Practice...150

6.7 CONCLUSION 150

REFERENCES 152

APPENDICES 168

APPENDIX 1 DELPHI TECHNIQUE TOOL 168

APPENDIX 2 SECOND CIRCULATION QUESTIONNAIRE 171

APPENDIX 3: FOCUS GROUP DISCUSSION INTERVIEW GUIDE..178

APPENDIX 4: INITIAL SELF-PERCEPTION QUESTIONNAIRE 179

APPENDIX 5: FINAL SELF-PERCEPTION QUESTIONNAIRE 182

APPENDIX 6: WORK BASED ASSESSMENT FORM 185

APPENDIX 7: PARTICIPANTS INFORMATION SHEET 187

APPENDIX 8: CONSENT FORM...190

APPENDIX 9: PERMISSION LETTER 191

APPENDIX 10: PARTICIPANTS INFORMATION SHEET, CONSENT & QUESTIONNAIRE.................................192

APPENDIX 11: COMPETENCE PROFILE 194

APPENDIX 12: TOOL FOR CURRICULUM MAPPING AND COMPARISON WITH DEVELOPED COMPETENCIES 198

APPENDIX 13: ETHICS APPROVAL LATTER..199

LIST OF TABLES

TABLE 3.1: OUTLINE OF THE STUDY PHASES ALIGNED TO OBJECTIVES AND SELECTED DATA COLLECTION METHOD 44

TABLE 3.2: VALIDITY AND RELIABILITY STRATEGY 49

TABLE 3.3: VALIDITY AND RELIABILITY STRATEGY FOR PHASE II 53

TABLE 3.4: SHOWING CRITERIA FOR EVALUATING CHEST X-RAY FOR TECHNICAL SUFFICIENCY 59

TABLE 3.5: SHOWING THE CORRECT SCORE AND ACCEPTABLE COMPETENCE RANGE FOR EACH IMAGE 61

TABLE 4.1: SHOWING A SUMMARY OF THE PARTICIPANT DEMOGRAPHICS FOR PHASE 3........................66

TABLE 4.2 FREQUENCY OF PERFORMING AN EXAMINATION........................67

TABLE 4.3 SHOWING PARTICIPANTS' SELF-RATING OF COMPETENCY........................68

TABLE 4.4: SHOWING A POST HOC TEST FOR SELF-ASSESSMENT OF COMPETENCY........................69

TABLE 4.5: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN ANATOMY EVALUATION 72

TABLE 4.6: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN PATIENT POSITIONING........................73

TABLE 4.7: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN EXPOSURE EVALUATION 75

TABLE 4.8: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN CONTRAST EVALUATION 77

TABLE 4.9: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN IMAGE SHARPNESS EVALUATION 79

TABLE 4-10: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN IMAGE ANNOTATION EVALUATION 81

TABLE 4.11: SELF-ASSESSMENT VS ACTUAL COMPETENCE IN RADIATION PROTECTION 83

TABLE 4.12: CROSS-TABULATION OF VARIABLES WITH OVERALL COMPETENCE........................85

TABLE 4.13: CORRELATION MATRIX........................86

TABLE 4.14: TABLE SHOWING THE REGRESSION MODEL 87

TABLE 4.15 A: PHASE ONE PARTICIPANTS' ATTRIBUTES 88

TABLE 4.16: ADDITIONAL CATEGORIES........................90

TABLE 4.17: FINALISED COMPETENCY CATEGORIES 92

TABLE 4.18 A: PROFESSIONAL COMPETENCIES........................93

TABLE 4.19 B: PROFESSIONAL COMPETENCIES........................94

TABLE 4.20: CLINICAL COMPETENCIES 95

TABLE 4.21: INTERPERSONAL COMPETENCIES........................96

TABLE 4.22: PATIENT CARE COMPETENCIES 96

TABLE 4.23: TECHNICAL COMPETENCIES 97

TABLE 4.24: ADMINISTRATIVE AND MANAGEMENT COMPETENCIES 98

TABLE 4.25: FUTURE ROLES AND RESPONSIBILITIES........................99

TABLE 4.26: FGD PARTICIPANTS ATTRIBUTED 101

TABLE 4.27 A: THEMES AND SUB-THEMES FOR THE FGD........................102

TABLE 4.28: NUMBER OF COMPETENCES IN LINE WITH GENERATED COMPETENCY LIST........................117

TABLE 4.29: TECHNICAL ROLES REPRESENTED IN THE TEVTA CURRICULUM........................117

LIST OF FIGURES

FIGURE 1.1: PROBLEM ANALYSIS DIAGRAM 5
FIGURE 2.1LITERATURE MAP 15
FIGURE 2.2: TRIPARTITE RELATION OF STUDENT CURRICULUM AND HEALTH SERVICE 16
FIGURE 2.3: REVISED ADDIE MODEL....... 21
FIGURE 2.4: FIGURE SHOWING MILLER'S PRISM OF CLINICAL COMPETENCE....... 25
FIGURE 2.5: BASIS FOR JUDGMENT OF WBA....... 26
FIGURE 2.6: FACTORS INFLUENCING RADIOGRAPHER COMPETENCE 28
FIGURE 2.7: CONCEPTUAL FRAMEWORK....... 35
FIGURE 3.1 PHASE ONE THEMATIC AREAS 46
FIGURE 3.2: IMAGE 1 57
FIGURE 3.3: IMAGE 2 57
FIGURE 3.4: IMAGE 3 58
FIGURE 3.5: IMAGE 4 58
FIGURE 3.6: IMAGE 5 59
FIGURE 4.1: FREQUENCY OF CHEST X-RAY EXAMINATION PERFORMED PER HOSPITAL 67
FIGURE 4.2: SHOWING PARTICIPANTS' SELF-RATING OF COMPETENCE 69
FIGURE 4.3: SHOWING PARTICIPANTS PERFORMANCE ON ANATOMY EVALUATION....... 70
FIGURE 4.4 SHOWING PERFORMANCE OF PARTICIPANTS' ON ANATOMY EVALUATION 71
FIGURE 4.5: PATIENT POSITIONING....... 72
FIGURE 4.6: PATIENT POSITIONING....... 73
FIGURE 4.7: RATING OF EXPOSURE EVALUATION 74
FIGURE 4.8: AGGREGATED EXPOSURE SCORE VS STANDARD SCORE 75
FIGURE 4.9: RATING OF CONTRAST EVALUATION 76
FIGURE 4.10: AGGREGATED CONTRAST SCORE VS STANDARD SCORE 77
FIGURE 4-11: RATING OF SHARPNESS EVALUATION....... 78
FIGURE 4.12: AGGREGATED SHARPNESS SCORE VS STANDARD SCORE....... 79
FIGURE 4.13: RATING OF IMAGE ANNOTATION 80
FIGURE 4.14: AGGREGATED IMAGE ANNOTATION SCORE VS STANDARD SCORE 81
FIGURE 4.15: RATING OF RADIATION PROTECTION ADEQUACY 82
FIGURE 4.16: AGGREGATED RADIATION PROTECTION SCORE VS STANDARD SCORE....... 83
FIGURE 4.17: OVERALL PERFORMANCE ACROSS THE DIFFERENT CATEGORIES....... 84
FIGURE 4.18: LEVEL OF AGREEMENT WITH THE DESCRIPTION....... 91

FIGURE 4.19: LEVEL OF AGREEMENT WITH CATEGORISATION....................92
FIGURE 4.20: THEMATIC AREAS....................102
FIGURE 4.21: RATING OF SUBORDINATE TECHNICAL ABILITIES....................112
FIGURE 4.22: RATING OF SENIOR RADIOGRAPHERS....................113
FIGURE 4.23: DISTRIBUTION OF THE COMPETENCIES IN 2004 TEVETA RADIOGRAPHY CURRICULUM....................116
FIGURE 6.1: THREE PILLAR INFORMATION GATHERING FRAMEWORK FOR CURRICULUM EVALUATION....................147

ABBREVIATIONS AND ACRONYMS

ADDIE	Analysis, Design, Development, Implementation, and Evaluation
ADCH	Arthur Davison Children Hospital
ASRT	American Society for Radiological Technologists
CBD	Case-Based discussions
CDH	Cancer Diseases Hospital
CI	Confidence Interval
CIPP	Context, Inputs, Products and the Processes
CM	Critical Model
CPD	Continuous Professional Development
CTH	Chipata Teaching Hospital
EHC	Evelyn Hone College
EU	European Union
FGD	Focus Group Discussions
GRZ	Government of the Republic of Zambia
HPCZ	Health Professions Council of Zambia
IAEA	International Atomic Energy Agency
ICT	Information Communication Technology
IQR	Inter Quartile Range
ISRRT	International Society of Radiographers and Radiological Technologists
LAMU	Lusaka Apex Medical University
Mini CEX	Mini Clinical Examination
MoH	Ministry of Health
MSTVT	Ministry of Science, Technology and Vocational Training
NHS	National Health Service
NTH	Ndola Teaching Hospital
OBM	Outcomes-Based Model
OSATS	Objective structured assessment of technical skills
OSCE	Objective Structured Clinical Examination
PA	Posterior-Anterior
PACS	Picture Archiving and Communication System

PBM	Process-Based Model
QA	Quality Assurance
QUAADRIL	Quality Assurance Audit for Diagnostic Radiology Improvement and Learning
RCS	Radiographers' Competence Scale
RIS	Radiological Information System
RSZ	Radiological Society of Zambia
SCID	Systematic Curriculum Instructional Development
SD	Standard Deviation
SoR	Society of Radiographers
TCM	Traditional Content Model
KTH	Kitwe Teaching Hospital
TEVETA	Technical Educational, Vocational and Entrepreneurship Training Authority
UK	United Kingdom
UNZA	University of Zambia
UTH	University Teaching Hospital
WBA	Workplace-based performance assessment
WFME	World Federation for Medical Education
ZAQA	Zambia National Qualification Framework

DEFINITIONS IN TERMS

Assessment is the systematic collection of information about student learning, using the time, knowledge, expertise, and resources available, in order to inform decisions that affect student learning" (Walvoord, 2010).

Competency is a combination of skills, knowledge, attitudes and the ability required in the performance of clinical roles with desirable outcomes (Andersson et al., 2012b).

Curriculum is a sophisticated blend of educational strategies, course content, learning outcomes, educational experiences, assessment, the educational environment and the individual students' learning style, personal timetable and programme of work."(Harden, 2001).

Evaluation this is a process that "attempts to identify the sources of variation in programme outcomes both from within and outside the programme while determining whether these sources of variation or even the outcome itself are desirable or undesirable." (Frye and Hemmer, 2012).

Radiographers is an individual qualified by training to undertake imaging procedures for the purpose of generating diagnostic information required in the management of a patient (Ehrlich and Daly, 2009). In this study, only diploma level radiographers were considered.

Workplace-based assessment (WBA) Is a process of drawing reasonable inferences about what an individual's knowledge, skills and attitudes are, based on evidence derived from observations of that individual in an actual practise setting and is predominantly carried out in the workplace (McKimm and Swanwick, 2013).

CHAPTER 1 INTRODUCTION

1.1 Introduction

There is a direct link between the competence of a health worker and the quality of care offered to patients (Andersson et al., 2012b). The competence level of the health worker is linked to the type of training and curriculum used for the training. It follows, therefore, that the curriculum must be alive to the contemporary requirement for practice. According to Williams and Berry (1999), the competence of a radiographer is shaped by the; requirements of the employers (fitness for purpose), professional and statutory bodies (fitness for practice) and training institutions (fitness for award). The need to meet the tripartite requirement has resulted in the definition of standards of performance or competencies which can be used to develop curriculum to be used in the training of radiographers (Mackay et al., 2008). It follows that any training programme that envisages producing radiographers that meet this minimum requirement must design and implement the training in such a way that satisfies the tripartite requirements of the employers, professional and statutory bodies, and the training school (Ng et al., 2008, Pratt and Adams, 2003). One way of ensuring this is to assess the competencies of radiographers in practice. Assessment in a work environment is referred to as workplace-based performance assessment (WBA) (Norcini, 2005).

This chapter contextualises the problem of diploma radiography training and outlines the questions that were set for the study. The background is presented first followed by the statement of the problem, research questions, and objectives. Furthermore, the chapter provides a synopsis of the conceptual definitions and the thesis layout.

1.2 Background

Radiography training in Zambia at diploma level commenced in 1970 at Evelyn Hone College (EHC). Over time, the curriculum review process has been erratic with only five (5) reviews in the past forty-six (46) years. The time interval between review is recommended to be at least five (5) years, however, this has not been the case in the Zambian context. The current curriculum was designed, and its implementation is monitored by the Technical Educational, Vocational and Entrepreneurship Training Authority (TEVETA) (TEVETA, 2005). The TEVETA 2004 curriculum outlines the following as required competencies:

a. Provide competency in radiography skills among radiographers for all levels of Health care and safely perform a wide range of radiological techniques in varying circumstances.
b. Provide improved radiological services for high-level efficiency and client satisfaction.
c. Adequately manage the radiographic resources towards the support of various levels of health care delivery systems
d. Exhibit an analytical approach to presented issues, thereby safeguarding justifiable professional decisions, and elicit the desire for further studies among radiographers.

Situations like the one in the Zambian diploma radiography training where the erratic reviews are apparent, there is a likelihood of a mismatch between curriculum and contemporary practice requirements. The issue of mismatch between competency requirement for practice and educational training has been explored in medical and non-medical fields. However, this aspect has not been exhaustively explored in the field of radiography. In a study conducted by Gonzalo et al. (2018), they used a survey to gather information regarding the required

competency in a health faculty development programme. Using this approach, they managed to gather information which was used to improve the concordance of the programme to contemporary requirements. The problem of mismatch has been identified in other fields. Studies in accounts, information technology, and engineering, showed a mismatch between contemporary competencies and stated training outputs (Peng et al., 2016; Matlay et al., 2014; Marzo-Navarro et al., 2009; Jonbekova, 2015).

1.3 Problem statement

There is a probable risk of a curriculum and workplace requirement mismatch for radiographers trained at diploma level in Zambia and currently practising in all the three levels of healthcare delivery. The risk exists probably on account of relatively static curricula due to periodic curriculum review practices (Finch and Crunkilton, 1999). There have been five reviews of the radiography diploma curriculum in the forty-six (46) years of the existence of the programme, with the last review in 2014.

Ideally, the curriculum should be reviewed every five (5) years, and during the review process performance of graduates of the curriculum should match the expectations of the job. Currently, the review period by TEVETA has been over ten years, and assessment of performance in the workplace of the graduates has never been a measure of curriculum alignment with job expectations.

Such an erratic review process raises the possibility of a mismatch between the curriculum and workplace requirements. Such a mismatch can bring about doubts in the fitness for practice of these radiographers. This training and fitness for practice mismatch could result in poor patient outcomes due to misdiagnosis resulting from poor radiography services. This situation can in some cases even cause mortality (Mraity et al., 2014).

A problem analysis (see problem analysis diagram, figure 1.1) was undertaken to provide insight to other contextual factors that can impact the levels of competence. The identified factors include; training, professional and legal environment, work environment, and curriculum development process. The training factors could comprise of issues related to assessments, teaching methods and availability of teaching facilities (England et al., 2017). The professional and legal environment speak to what a radiographer is allowed to do and their professional conduct in the execution of their jobs. The factors shape the competence framework (William and Berry 2000). The conditions and the work environment may also affect the competence levels (Sloane and Miller, 2017). Whilst these may be contributory factors, the focus of this study was on factors surrounding curriculum review. One method of measuring fitness for practice that is gaining attention is the use of WBA (Norcini, 2005). Therefore, this study sought to establish the role of workplace-based assessment of radiographers in informing curriculum development practices.

A search using search engines with a vast repertoire of radiography information, Science Direct, Google Scholar and PubMed did not yield evidence of WBA of newly qualified radiographers having been conducted in Zambia. Furthermore, TEVETA uses an expert panel approach for determining job requirements and not necessarily an actual WBA (TEVETA, 2010).

1.4 Study purpose

The purpose of the study was to investigate the role that WBA can play in improving radiography curriculum development and evaluation process in Zambia. Furthermore, sought to develop a framework for curriculum review that can potentially improve radiography practice and training. In addition, to contribute to the body of evidence that can inform better

curriculum development policy at TEVETA and universities planning to introduce radiography training in Zambia.

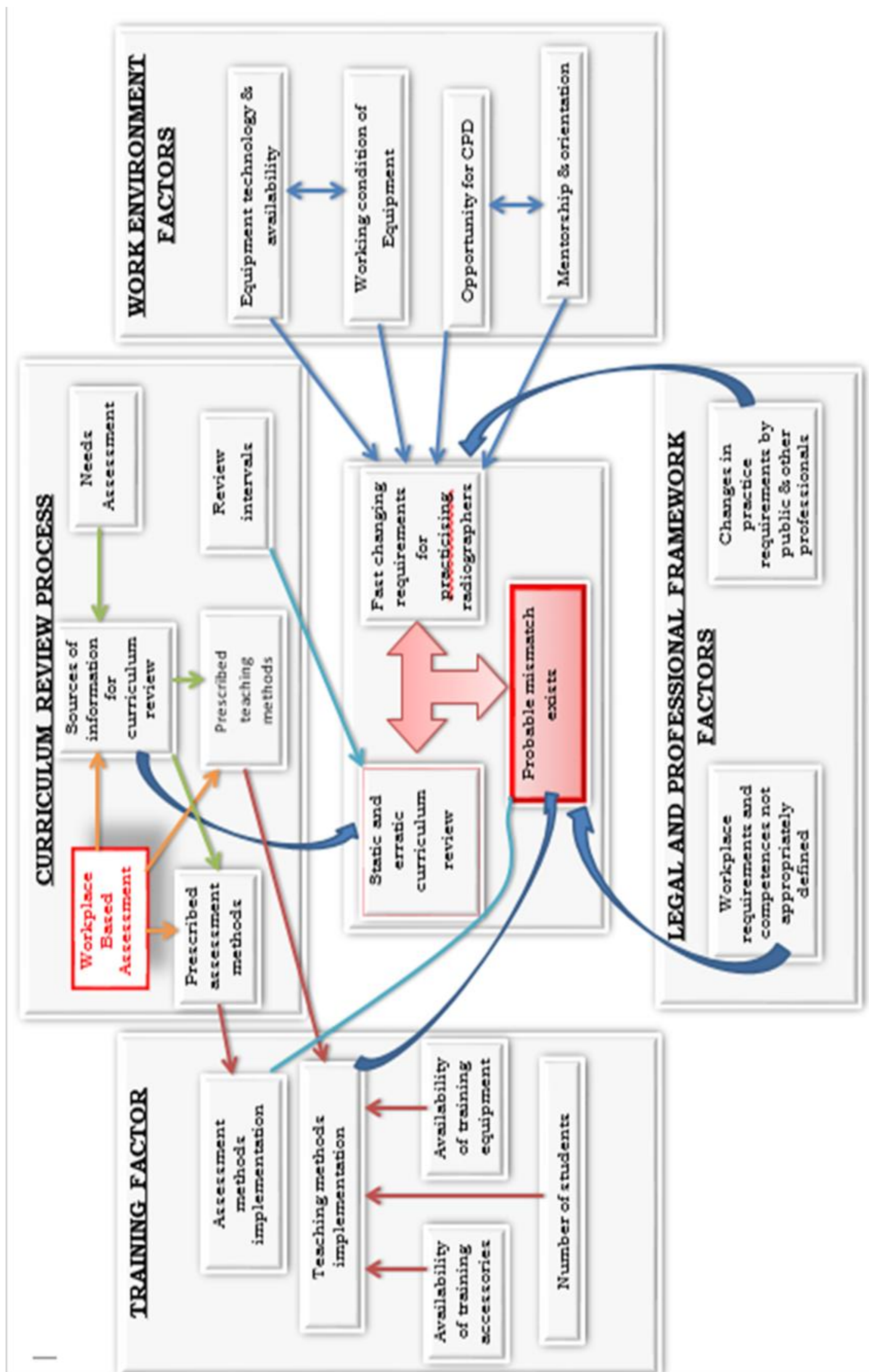

Figure 1.1: Problem analysis diagram

1.5 Significance

The current radiography training programme has produced about 450 students between 1970 and 2011 (Munsanje, 2014). Furthermore, enrolment numbers per intake have more than trebled with the current intakes comprising over 60 students per year. The majority of the graduates of the programme are employed in the three levels of public healthcare provision in Zambia. When the fitness for practice for all these individuals is brought into question, the implication is profound for all the levels of healthcare. Furthermore, in this era of litigation, providing assurance of fitness for practice cannot be overlooked. Another equally important consideration is that 'O' level students now have a wide choice of career paths to choose from, as such in order to remain competitive with other training programmes, radiography training must be seen as a career path that will provide these would be graduates a secured career.

Training institutions such as the University of Zambia which have started or are planning to start such training programmes at undergraduate degree level, stand to benefit from outcomes of a study of this nature: such outcomes will assist in their curriculum development and review process. This has demonstrated the impact of WBA on curriculum design, development and review processes. Additionally, the study has demonstrated that curriculum evaluation has real implications for patients, healthcare providing institutions student and the public as a whole. These aspects all combine to justify the significance of the study.

1.6 Research questions

1.6.1 Main research question

How can workplace performance assessments inform curriculum development and attendant assessment practices in order to improve the concordance of radiographer training and job requirements of radiographers who graduated after 2010 from the TEVETA training programme?

1.6.2 Specific questions

i. What are the contemporary job competencies for diploma radiographers working at the various levels of health service delivery in Zambia?
ii. How are post-registrations radiographers who graduated from the TEVETA radiographer training after 2010 meeting the job requirements of a radiographer for primary, secondary, and tertiary care in Zambia?
iii. To what extent does competency of post-registration radiographers in plain x-ray technical sufficiency assessment correlate with self-perception assessment of radiographers who graduated from the TEVETA radiographer training after 2010
iv. How are the TEVETA curriculum outcomes matching the contemporary requirements and actual performance of graduates working in various levels of health service delivery in Zambia?

1.7 Research aim and objectives

The purpose of the study was to establish how WBA can inform radiography curriculum development thereby improving radiography practice and training by contributing to the

body of evidence that can inform better curriculum development policy at TEVETA and universities planning to introduce radiography training.

1.7.1 Main research objective

To establish how WBA can inform curriculum development and attendant assessment practices in order to improve the concordance of radiographer training and job requirements of contemporary radiographers.

1.7.2 Specific Objectives

i. To establish the contemporary job competencies for diploma radiographers working at the various levels of health service delivery in Zambia.
ii. To analyse the extent to which post-registrations radiographers who graduated from the TEVETA radiographer training programme post-2010 are meeting the job requirements of a radiographer for primary, secondary, and tertiary care in Zambia.
iii. To evaluate the competency levels of post-registration radiographers who graduated from the TEVETA radiographer training after 2010 in plain x-ray technical sufficiency assessment and correlate with their self-perception.
iv. To establish how the TEVETA curriculum outcomes match the contemporary requirements and actual performance of graduates working in various levels of health service delivery in Zambia.

1.8 Rationale

In contemporary health professions education, it has been argued that a symbiosis must be achieved between curriculum and healthcare services to such an extent that the curriculum

enhances health service delivery (Prideaux, 2003). Therefore, a measure of the successful outcome of any such training is the demonstration of the appropriate clinical competence of the graduates of that programme in a work environment (Mc Inerney and Baird, 2016). Bearing in mind this point of view, invariably, the practice of radiographers should inform curriculum development of radiography programmes, and in turn, the quality of such programmes measured by assessment outcomes of its graduates. In this regard, the curriculum used to train these individuals must be reflective of contemporary practice requirements (Prideaux, 2003). In the event of such a curriculum being out-dated, a probable risk may exist of a mismatch between workplace requirements and the curriculum (Finch and Crunkilton, 1999). In order for training programmes to remain relevant, curriculum developers must ensure that the curriculum development and review process guarantees the necessary stakeholders that all the facets required in the training of practitioners attuned to contemporary practice have been included.

A review of graduate's performance in an actual work environment, also referred to as Workplace Based Assessment (WBA) would, therefore, provide vital information to this review process (Norcini, 2005). In essence, a curriculum that is regularly reviewed and founded on workplace performance would retain a kind of dynamism that would render it abreast with contemporary job requirements of radiographers (Finch and Crunkilton, 1999). Demonstrating the impact of WBA on, curriculum design, review and development, and assessment can introduce another method of ensuring that the graduates from such programmes meet the requirements for practice.

1.9 Key findings and implications for theory and practice

The push of the study was to establish how WBA can be used in the curriculum development or review process. The WBA indicated that the majority (74%) of the participants were not competent in the technical evaluation of chest x-rays. These findings correlated with the views of senior/supervising radiographers who also alluded to such an assertion based on their interaction with the post-2010 registered radiographers working in Government hospitals. However, the mean score on the self-evaluated competency was 26.77 out of a possible score of 35 (representing 76%). This score indicated a high level of perceived competency. This contradictory position highlights the assertion that relying on self-assessment may be misleading.

In terms of the contemporary practice requirements, the list generated from the first and the second phase of the study are in line with the requirement for practice by the various international organisations such as the Society of Radiographer (SoR) of the United Kingdom (UK) and the International Society for radiographers and radiological technologist (ISRRT).

An examination of the 2004 TEVETA diploma radiography curriculum revealed that competencies associated with technical requirements for practice were very few (3%). In drawing conclusions, the regression model demonstrated that only sex and high perception affects the odds of being competent. When all the factors are considered, work environment and years of experience were not regarded as substantial factors affecting competence. It can be assumed that the role that training and curriculum play in competence development is quite significant.

We have shown that the assessment outcomes provide useful indicators as to which aspect of the curriculum requires attention. Combined with other data sources, the review process

can yield a curriculum that is in tune with the contemporary practice requirements. In the determination of the value of WBA to curriculum review, those studied exhibited low levels of competence in the area of plain film technical evaluation. Such performance levels can bring into question fitness for practice for these individuals. It is recommended that subsequent curriculum reviews must explore and possibly reinforce the content, objectives, teaching, and assessment practices currently being used.

A framework termed ‘Three pillar information gathering framework for curriculum evaluation’ has been developed. This framework points to three information categories that must be generated and consulted before making decisions pertaining to curriculum change.

1.10 Outline of the thesis

This thesis is arranged into six chapters with a view of reporting the stages of the study process. The first chapter is the introduction; second, the literature review; third, methodology; fourth, results; fifth, discussion; and sixth, conclusion

Chapter one is the point of departure for the thesis. It provides an overview of the study by outlining the background and the thought process of problem delineation. It sets the context of the study by describing the gap that is created when curriculum review is erratic. The situation in Zambia concerning radiography training is highlighted. Furthermore, the streamlined questions and objectives that guided the study are presented. The theoretical assumptions in the form of conceptual definitions are also provided. Finally, a synopsis of the study findings is presented.

Chapter two provides a summary of the literature consulted in the development of the study. The review provides a highlight of the major theories that underpin the curriculum

development process. Areas of emphasis are on the models, instructional design, and evaluation. The concept of WBA and its use then is explored. Furthermore, the idea of competency in general and specifically to radiography is presented. Focus on the competencies is narrowed to evaluation technical competencies of radiographers. The historical perspectives and contemporary radiography practice in Zambia are then highlighted. The chapter concludes by presenting a conceptual framework that guided the study development and execution.

The third chapter outlines the study design and specific methods employed for the data collection, analysis and synthesis. The point of departure for the chapter is the description of the research paradigm and the design considerations. The study took a phased approach to implementation. A detailed description of the study participants; data collection process; analysis; ethics consideration; and reliability and validity issues for each phase of the study are outlined.

The fourth chapter presents the study findings. These findings are presented with reference to the objectives and associated phase of data collection. The first results relate to the qualitative survey that sought to establish the contemporary job requirement for a radiographer working in the Zambian health sector. The phase two results pertain to the establishment of consensus on job competencies by the use of Focus Group Discussions (FGD). The results from the third phase detail the findings from self-evaluation of competency by the radiographers and WBA conducted on the same radiographers. The outcomes from the desk review of the current TEVETA radiography curriculum are then presented.

Chapter five details the discussion that arose following the data collection and analysis. Critical areas of discussion were centred on the required competencies of radiographers practising in Zambia; self-evaluation of competencies by the said radiographers; and assessment of actual competencies. The comparison with stated curriculum outcomes was the last area of discussion.

The final chapter summarises the significant findings and recommendations of the study. It furthermore, outlines the limitations and implication for curriculum development.

1.11 Conclusion

Chapter 1 provided an overview of the study. The problem, research question, significance, rationale and conceptual definitions have been presented. The chapter also highlighted the main findings of the study. The subsequent chapters provide an in-depth presentation of the study methods, findings discussion, and conclusions.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature that assisted in the development and implementation of this study. The literature review was conducted with a view to identifying documented evidence related to the use of WBA in generating information that would aid in radiography curriculum review processes. This was with a view of identifying gaps and improving concordance between the contemporary requirement for practice and training structure as dictated by the curriculum. The study was situated in the Zambian context, and hence an understanding of the Zambian radiography training landscape was also essential. Hart (2018), notes that a literature review also contributes to informing the methodological assumptions and processes undertaken. Furthermore, the literature review must demonstrate a gap in the knowledge on a particular subject matter. In this regard, the chapter also illustrates the conceptual framework that guided this study.

The point of departure for the presentation of the literature reviewed is to demonstrate the linkages of the individual sections with the core theme for the study. The linkages are demonstrated in the literature map shown in figure 2.1. A literature map is a diagrammatic representation of the thought process illustrating the connection between the different elements of the reviewed literature and their link to the study (Hart, 2018).

The literature map depicts the central focus as the use of WBA in informing curriculum practices. The map is tied to the core problem of the study which is the erratic review of the diploma radiography programme resulting in a probable mismatch between contemporary requirements for practice; curriculum stated outcomes and manifest competencies of graduates from the said curriculum.

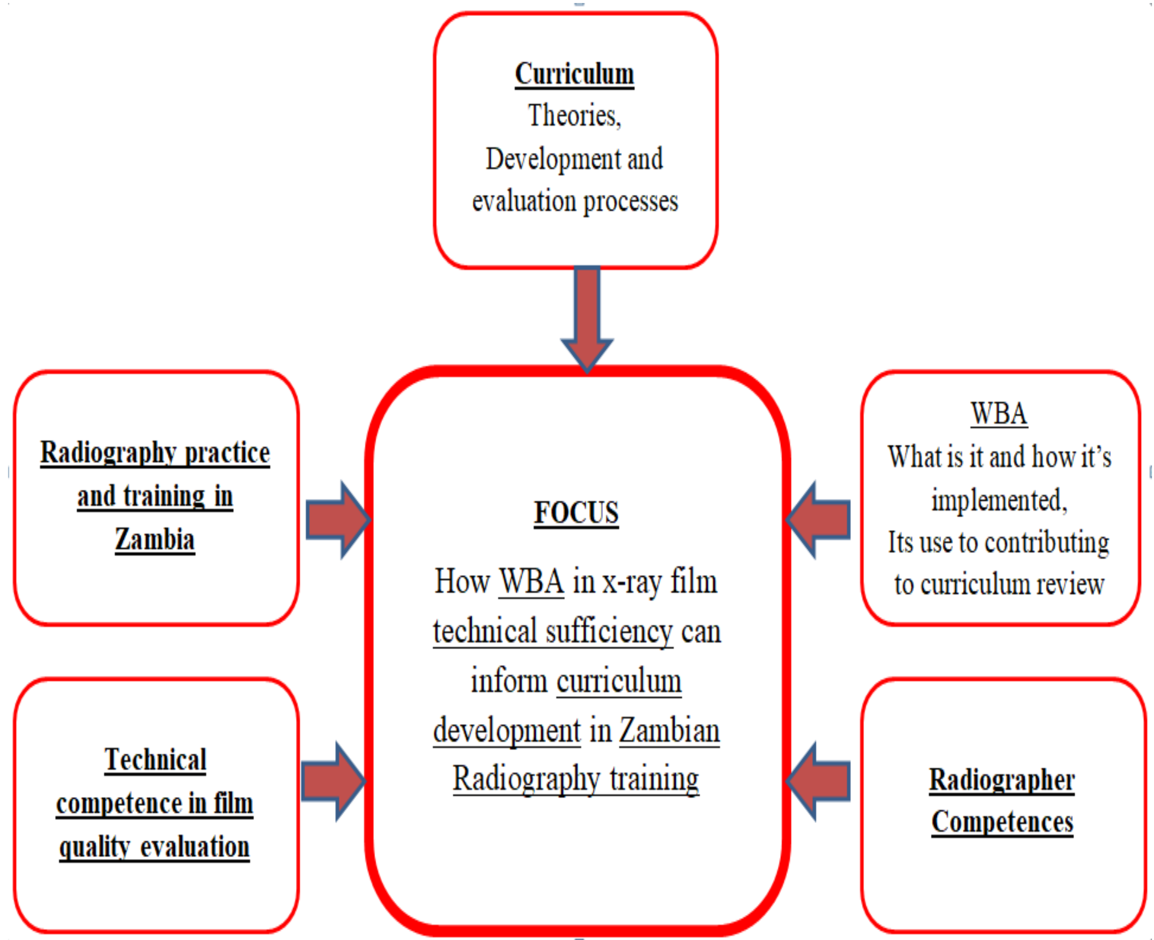

Figure 2.1 Literature map

(From current study)

Prideaux (2003), notes that critical links exist in a tripartite relationship of the curriculum, students and health service communities (Figure 2.2). It is necessary to have input from the health services communities in ensuring that the curriculum used in training meets the contemporary requirement for practice.

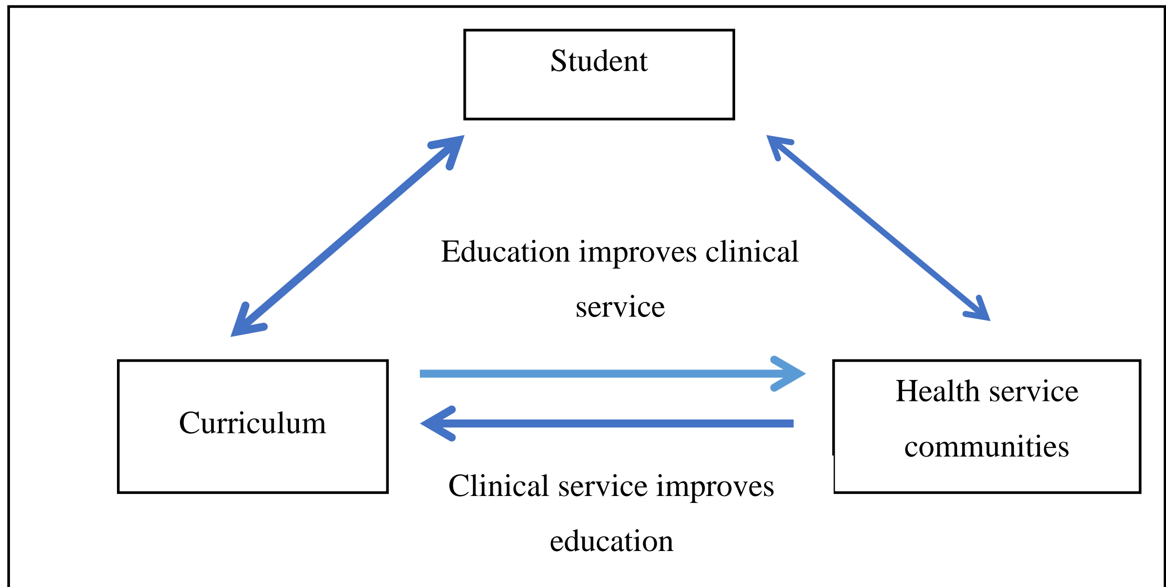

Figure 2.2: Tripartite relation of student curriculum and health service (Prideaux, 2003)

The literature map further shows the array of literature that was consulted to elucidate what is known and the processes to investigate it. Thorough understanding of the following five key areas was undertaken:

a. General principles and theories that guide curriculum design, development, implementation and evaluation. The focus was on health-related training and specifically on radiography training.
b. WBA and its use in curriculum evaluation. The emphasis was to understand it as a concept, outlining its strength and weakness, and methodology of its implementation.
c. Radiography competences and the requirement for contemporary practice. This was undertaken to ensure a thorough grasp of the requirements for practice internationally and then relate to the local situation. Additionally, it was also essential to explore the issue of technical competence as this related directly to the core theme of assessing technical sufficiency of radiographers practising in Zambia. Related to the technical

sufficiency, the specific tool that was used to measure technical sufficiency was an evaluation for quality of a plain chest X-ray. An In-depth review of the parameters that guide image quality was critical.

d. The last aspect was the understanding of the Zambian practice and training situation.

The elements were important in creating an understanding of the subject matter, developing and implementing the study, providing a context to analyse the data and draw conclusions. The summary and critique of the literature in the five areas noted is presented below.

2.2 Curriculum design, development, implementation and evaluation

Key to achieving the objective of the research was a thorough understanding of the curriculum design, development, implementation, and evaluation process. Literature was engaged to elucidate each of these steps. Particular emphasis was placed in providing a context by examining the theories that support the different practice approaches.

2.2.1 Theories underpinning curriculum development

There are several theories that endeavour to explain the curriculum and the processes engaged in the development and subsequent review. In analysing these, it is vital to provide a context of the understanding curriculum. According to Harden (2001), "The curriculum is a sophisticated blend of educational strategies, course content, learning outcomes, educational experiences, assessment, the educational environment and the individual students' learning style, personal timetable and programme of work." It is essential to distinguish a curriculum from a list of contents to be taught (syllabus). The World Federation for Medical Education (WFME) prescribes that a curriculum should have the following minimum:

- Mission and outcomes

- Educational programme
- learning and training process
- Assessment of learning
- Students and trainee characteristics and needs
- Staffing and faculty
- Educational resources and training settings
- Evaluation of the educational programme and process
- Governance and administration
- Curriculum renewal

(WFME, 2015)

There are several theories in the realm of curriculum design and development. According to Prideaux (2003), the curriculum has four major elements: content; teaching and learning strategies; assessment processes; and evaluation processes. He further notes that the curriculum design process involves defining and organising these elements into a logical pattern.

Several pathways can be taken with regard to the design process. Prideaux (2003), classifies the models used into two broad categories, prescriptive and descriptive models. The significant distinction in the categories is that the models that are prescriptive attempt to answer; what curriculum designers must do, and how to generate a curriculum. On the other hand, descriptive models concentrate on; what curriculum designers actually do and what a curriculum covers.

One of the well-known prescriptive models is the objective model which arose from the initial work of Ralph Tyler in 1949. This is now replaced by an Outcome-based model (Woods et al., 2010). The premise of these models is that learning should be defined in terms of what students should be able to do once the programme is complete. The point of departure in this approach is to define the job profile of the individual to be produced by the curriculum. Advocates for this approach note that the curriculum is meant to address a specific need in society and hence that need requires to be clearly outlined before any attempt to design content (Woods et al., 2010). A significant criticism of this model is that it removes the context of both internal and external factors (Grant, 2013).

An example of a descriptive model is the situational model by Skilbeck postulated in 1976. This model is an iterative, cyclical model that starts with a situation analysis. The emphasis in this model is on the importance of situation or context in curriculum design (Prideaux, 2003b). The use of this model can be particularly useful in the context of trying to use workplace-based assessment because the workplace provides the framework in which graduates practice. McKimm (2010) notes that an approach of combining can also be taken. The TEVETA approach to curriculum development appears to be an eclectic model borrowing from approach or assumptions from both the descriptive and prescriptive schools of thought.

Woods et al. (2010) identify four (4) curriculum models which include; Outcomes-Based Model (OBM), Process-Based Model (PBM), Critical Model (CM), and Traditional Content Model (TCM). As noted in the preceding, OBM concentrates on outlining the competencies that the learner will attain following completion of training. Opponents of this approach note that it provides only a narrow view of the learning process. The PBM tends to treat curriculum

in terms of a developmental continuum of educational experiences and processes. It is vastly aligned to the constructivists' orientation of emphasising on experiential learning. According to Woods et al. (2010), the CM has had little impact on the technical form of the curriculum but has directly addressed content issues and tends to stress higher-order or critical skills. The TCM has its roots in the work of Bloom et al., who created a taxonomy of learning objectives. The emphasis of this model is the technical listing and prescription of content knowledge, prescribed reading and topics. As noted previously, most curricular tend to combine these distinct approaches in order to arrive at a document that suits their context. In this regard, strict adherence to one method may disadvantage curriculum developers seeking to find a curriculum that is deliverable in prevailing social and economic environments.

2.2.2 Instructional design process

In as much as varying approaches are available, the actual process undertaken must be clear for the purpose of reviewing and improving a curriculum. In spite of the various viewpoints on the models of curriculum, there is general agreement on the steps that should be undertaken in the curriculum development or review process (Grant, 2014). They further highlight that four fundamental aspects must be addressed; establishing the purpose, organisation, experiences and evaluation. Harden (1986) advocates that ten questions need to be adequately explored when designing a curriculum. The aspects to be questioned are; need for the programme, aims and objectives, content, content organisation, educational strategies, instructional methods, assessment methods, curriculum communication, required environment, and management of the curriculum.

One model for instructional design that has been used is the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model (Gustafson and Branch, 2002, Arkün and

Akkoyunlu, 2008). In the analysis phase, a need must be first established prior to the design of the curriculum or course. This helps to set the context of the training. The design establishes the content, teaching methods, and assessment methods, while implementation relates to the planned activities that actualise the curriculum. The evaluation seeks to determine the impact of the intervention.

This systems approach has been extended, as reported by Allen (2006). The Figure 2.3 below illustrates the expanded scope as published by Allen.

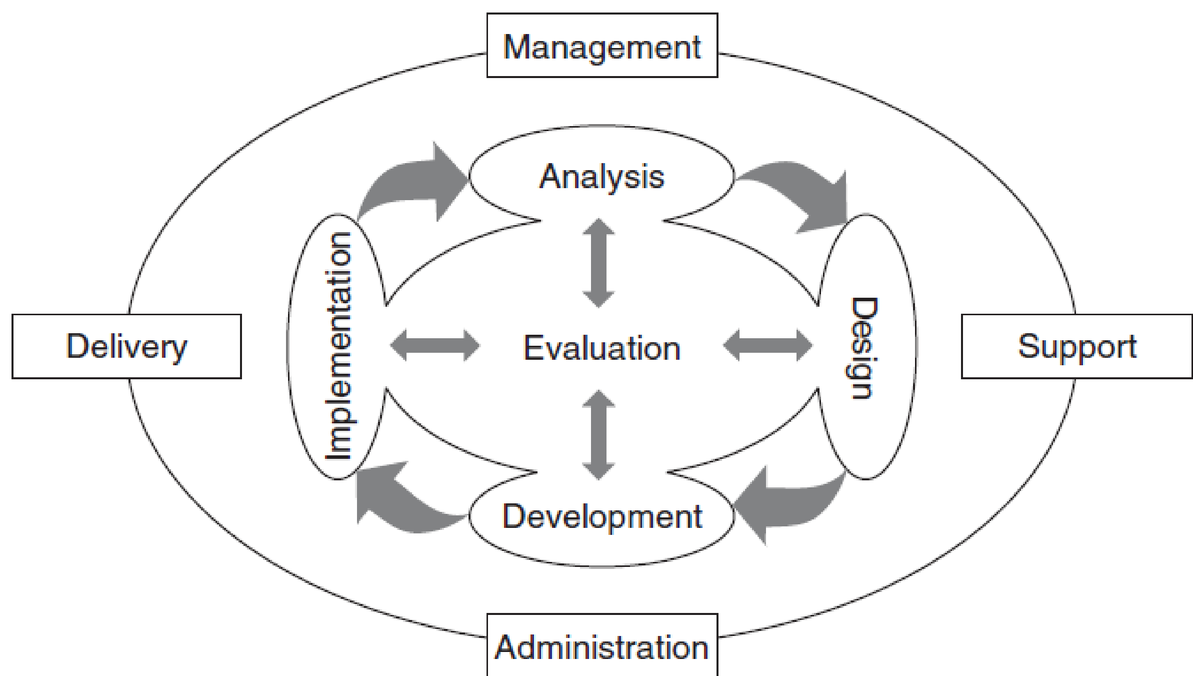

Figure 2.3: Revised ADDIE model

(Allen, 2006).

In this approach, the framework includes administration and management system that supports the entire process.

2.2.3 Evaluation of educational interventions

Educational evaluation is now taking a central role in the educational process. It plays a critical role in passing judgement on the merit, worth, value, and impact of an educational intervention. Ultimately evaluation is essential for quality monitoring and improvement (Ni, 2010). According to Mathison (2010), evaluation is also crucial to provide accountability to the general public. This is very vital especially for health professions training where the products of the training programme have a direct bearing on the service delivery. The models of evaluation can be classified as being system based or goal-based (Zinovieff and Rotem, 2008). Several frameworks have been postulated concerning evaluation. In education, the most prominent are Kirkpatrick's and Stufflebeam's models.

According to Kaufman and Keller (1994), the Kirkpatrick model approaches evaluation from four levels one (1) through to four (4) with the first level being the base of a triangle and the fourth the apex. Level 1, in this model, seeks to evaluate the reactions of learners' satisfaction. The second level evaluates the learning by providing information on knowledge and skills acquisition. In the third level, the concentration is focused on the evaluation of the learners' behaviour. The ultimate evaluation is in the fourth level where the impact on the society is evaluated. Kaufman and Keller (1994) have modified this model and have coined it the 'Kirkpatrick plus'. In this expanded version Kaufman and Keller include a fifth level which focuses on the impact and consequences in and for society. Another modification is proposed to the first level by including consideration and determination of the value and worth of resources and methods. The last amendment proposed by the dual was the extension beyond training to human and organisational performance.

One of the most prominent system-based models is the Stufflebeam's model. In this model of evaluation efforts must be undertaken to evaluate the factors associated with; Context, Inputs, Products and the Processes. The model is popularly referred to as the CIPP model. The CIPP model that was used as a framework for this study attempts to cover the three aspects of summative evaluation, formative evaluation and knowledge generation (Hakan and Seval, 2011). In the present study, the emphasis was on evaluating the product of the training.

2.2.4 Curriculum evaluation

An essential part of the educational system evaluation is the interrogation of a curriculum to ensure that the stated outcomes are being attained. Evaluation of the curriculum can impact on what is taught and learnt. Furthermore, it can facilitate to describe, judge, qualify, understand, and/or enhance new knowledge concerning school curricula (Levin, 2010). Levin (2010) furthermore notes that the process of curriculum evaluation tends to serve a tripartite end of curriculum improvement (formative evaluation), judgement purposes (summative evaluation), and Knowledge generation. The focus of the formative evaluation is on making the curriculum better rather than making it different. Summative evaluation, on the other hand, seeks to answer the questions 'should we continue with this curriculum, and are the outcome what we intended to have' (Levin, 2010).

In the cyclical model, various steps exist, these include; problem identification and general needs assessment, statement of the overall purpose of the curriculum, specifically intended achievements, curriculum organisation, educational experiences and evaluation. Evaluation of the curriculum is expected at any of the steps in the development process (Grant, 2013). Evaluation is "the consideration or examination of something in order to judge its value,

quality, importance, extent or condition. Evaluation encompasses evidence, conclusions, judgement and recommendations" (Owens, 2006).

2.2.5 Curriculum analysis

One of the objectives of the present study was to analyse the radiography curriculum in order to evaluate the alignment of contemporary competencies to stated curriculum competencies. In this regard, a review of literature also included elucidating the concept of curriculum analysis. According to Gottipati and Shankararaman (2018), curriculum analysis assists in establishing the components of a curriculum to assess it and possibly improve it. Several methods have been proposed to evaluate a curriculum. One approach is by the use of a curriculum map (Harden, 2001). A curriculum map is a spatial representation of curriculum components in order to present a whole picture of the curriculum and the associated relationships and connections between the parts (Willett, 2008).

In a study conducted by Uchiyama and Radin (2009) they showed that curriculum mapping provides a method that allows not only for alignment of a curriculum but also fosters a spirit of comradeship amongst faculty. This outcome was also arrived at in a study by Plaza et al. (2007). Plaza et al. noted that curriculum mapping was useful in making meaningful sense of existing data in curriculum evaluation. Others have also arrived at the same conclusions (Willett, 2008; Uchiyama and Radin, 2009; Oliver et al., 2010; Merritt et al., 2012).

2.4 Workplace based Assessment

Concomitantly, outcome consideration, in the form of assessments, has been advocated as a more effective criterion for assessing the quality of educational programmes (Norcini and Banda, 2011). One method of measuring fitness for practice that is gaining attention is the

use of WBA (Norcini, 2005). Premised on the assumption that the assessment of clinical competence can be based on Miller's pyramid (Norcini, 2003).

According to Miller (1990), the pyramid is a framework that has been used to measure the competencies of individuals in any training programme (Figure 2.4). Miller notes that the framework is organised as a pyramid with four levels. The base forms the foundations. It is argued that the firmest foundation is based on knowledge. The framework, therefore, emphasises that knowledge must be assessed as a precursor to assessing other factors. The other levels are 'Knows How', 'Shows How', and 'Does'.

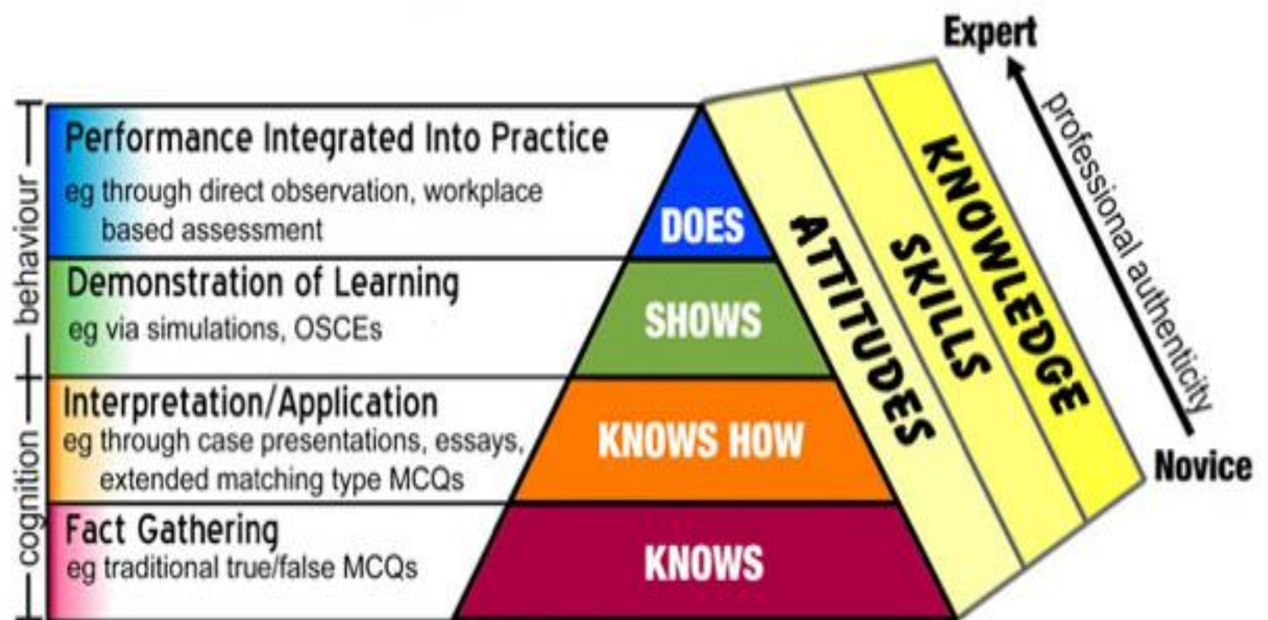

Figure 2.4: Figure showing Miller's prism of clinical competence

(Mehay and Burns, 2009)

WBAs target this highest level of the pyramid and collect information about an individual's performance in their routine practice (Crossley and Jolly, 2012). WBA is a process of drawing reasonable inferences about what an individual's knowledge, skills and attitudes are, based on evidence derived from observations of that individual in an actual practise setting

and is predominantly carried out in the workplace (McKimm and Swanwick, 2013). WBA is gaining impetus because there is an increase in demand for quality improvement by the public hence a refocus on the assessment of work (Southgate et al., 2001; Overeem et al., 2007; Norcini, 2003; Norcini, 2005).

It should be noted that no solitary method is appropriate for assessing clinical performance. Instead, they advocate for a multimodal approach (see Figure 2.5). For postgraduate students methods to assess performance include; Mini CEX, Case-Based discussions (CBD), Objective structured assessment of technical skills (OSATS), 360 degrees, and portfolio (Govaerts and van der Vleuten, 2013; Hayes and Easter, 2012).

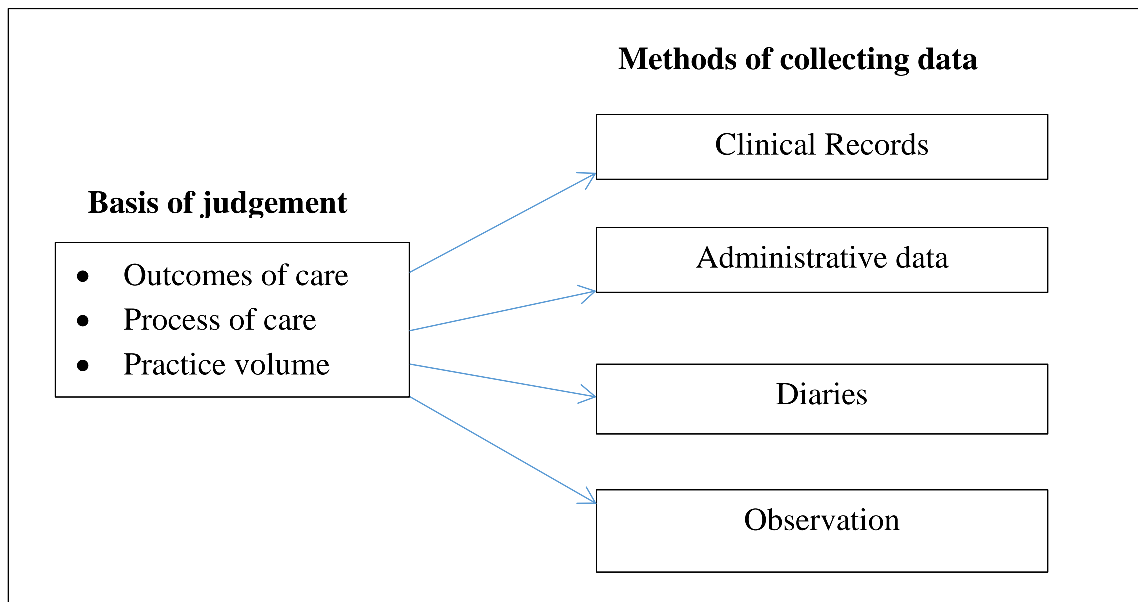

Figure 2.5: Basis for judgment of WBA

(Norcini, 2003)

Most of the systematic implementation has been at the level of postgraduate medical doctors. In the UK programmes, students have to undergo these assessments (Hayes and Easter, 2012).

2.4.1 Validity and Reliability of WBA

Several issues have been raised concerning the validity and reliability of the various methods of WBA. These include; subjectivity in the allocation of marks, and inability to perform psychometric analysis (Archer and McAvoy, 2011; Crossley and Jolly, 2012). To enhance validity and reliability issues Govaerts and van der Vleuten (2013) advocate for the use of qualitative dimensions of trustworthiness.

2.5 Competency in radiography

A study by Williams and Berry (1999) outlined seven (7) competence categories for a radiographer. These include; professional, clinical, interpersonal, patient care, technical, administrative, and theoretical. Williams and Berry (1999) argue that in order for a radiographer to meet requirements for practice, they should be proficient in these seven (7) competence categories. These standards of competence were used as a bench mark for comparison in our study. It must be noted that the clinical competency is cardinal as it links to actual practice excellence.

Assessment of clinical competency of both qualified radiographers and radiographers in training has in the recent past attracted attention (Kilgour, 2011). Kilgour notes that the variations in the methods of assessment have given rise to difficulties in standard evaluation of clinical competencies.

Biggs (1999) further notes that in assessing the clinical competency assessment methods linked to Miller's Shows How and Does levels are critical. It is therefore vital that the learning activities learners are exposed to have a healthy blend of both didactic and practical experiences. The assertion is that if a student can apply theoretical concepts in different

clinical situations then the student has indeed learnt. However, what remains in most of these cases are to define competencies and the factors that shapes it.

One area that informs the competence requirement for radiographers is the concept of fitness for practice (Williams and Berry, 1999). "Fitness for Practice" is widely accepted, and continues to inform ("End-in-Mind") design development and implementation of curricula. This is depicted in Figure 2.6. Radiography and other health professionals' curriculum now have an emphasis on attainment of competences (Castillo et al., 2011). Increasing pressure from communities that radiography graduates have the necessary academic and practical skills (Ng et al., 2008).

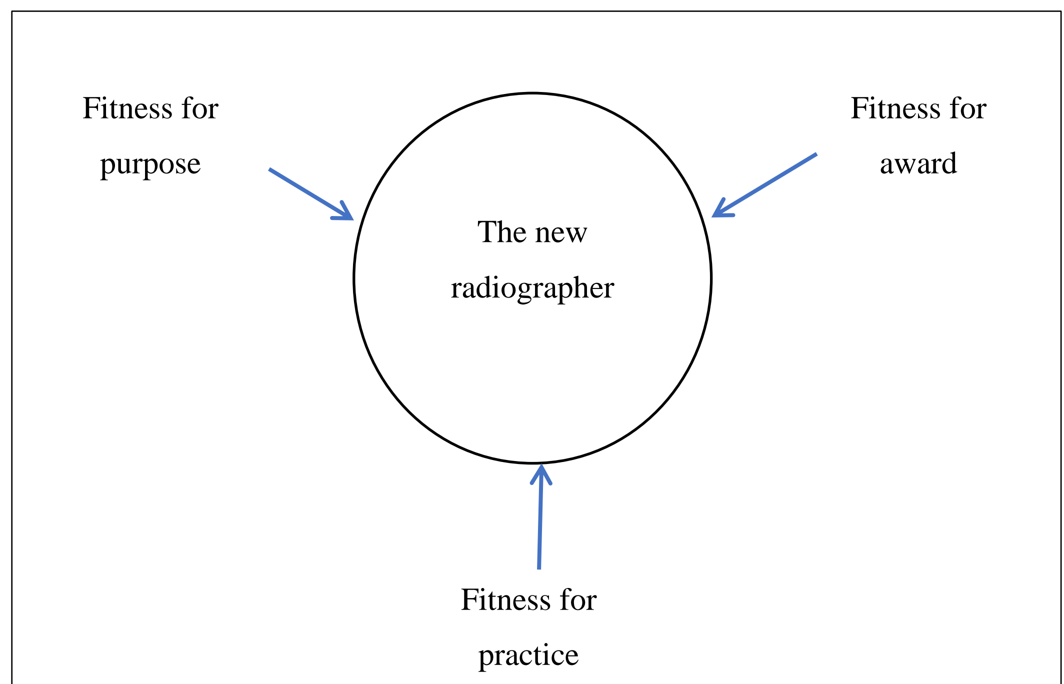

Figure 2.6: Factors influencing radiographer competence (Williams and Berry, 1999)

2.5.1 Assessment of overall radiographer competencies

Due to the rapidly evolving field of radiography, the competency profile of anyone practising radiography is very critical to ensuring professional standards (Vanckavičienė et al., 2017).

Furthermore, the issue of radiographers' competency is fundamental to patient outcomes (Andersson, 2012). In a study conducted by Vanckavičienė et al. (2017), radiographers and radiologists' perception of radiographer competency were evaluated. They concluded that the overall level of radiographers' competence was high or very high. Both the radiographers and radiologists attributed high or very high evaluations to patient care and technical and radiographic process domains.

In a national survey conducted by Andersson et al. (2012b), a psychometric evaluation approach was used in which a ten (10) scale was used to evaluate competencies. The tool used was a Radiographers' Competence Scale (RCS) with 28 items. The tool had two dimensions; Nurse-imitated care, and Technical and radiographic processes. A total of 406 radiographers took part. Assessment of Technical and radiographic process showed that those with long term experience used " Organising and planning taking account of the clinical situation', 'Prioritising patients in the workflow', 'Minimising radiation doses for patient and staff', 'Optimising the quality of the image' and 'Preliminary assessment of images' more often than those with short experience ($p<0.001$)". The self-reported competencies were also generally high. The competence level was significantly associated with age.

2.5.2 Assessment of radiographers' specific technical competencies

Several studies have been undertaken to evaluate the technical skills of radiographers in specific roles. Most of the studies have been linked to assessing role extension roles (White and McKay, 2002; Law et al., 2008; Judson and Nightingale, 2009; Jones and Manning, 2008).

Law et al. (2008) reported that when the skills of radiographers were compared to that of radiologists with regard to performing and reporting contrast barium enema studies, the

sensitivity score for radiographers was as 94.5%. They concluded in their research that with appropriate training radiographers could take up the extended roles. This same conclusion was reached by studies which investigated radiographer capability to report barium swallow, barium meal and skeletal images (Judson and Nightingale, 2009; Jones and Manning, 2008; Cascade et al., 2001; Brealey et al., 2009). The current studies focus on the evaluation of the image quality in terms of identifying technical flaws. This is a routine aspect of a radiographer's job as it requires such a radiographer to make a decision before passing a film for clinical analysis required for making a diagnosis.

2.5.3 Plain X-ray film image quality

This study was anchored on the ability of radiographers to evaluate the image quality as a surrogate for determining competence. Specifically, chest x-ray radiograph evaluation was used because of the frequency with which it is conducted in many radiology department in Zambia.

Plain film imaging is the most common procedures conducted in medical imaging departments. The radiograph produced after each procedure can serve as one of the markers of quality from that department. As such, all radiographers must be equipped with the skills to evaluate an image for quality before passing it on for diagnosis determination (Mount, 2016). During the post-imaging evaluation of radiographs, radiographers make decisions as to whether a repeat is necessary or not. A wrong decision at this point would result in either unnecessary exposure of patients to radiation or a possible misdiagnosis from a technically inapt radiograph. Inaccurate image interpretation resulting from poor imaging technique and quality assurance can be fatal (Mraity et al., 2014). Furthermore, inaccurate imaging

processes are not cost-effective (Hardy and Persaud, 2001). Radiographers must have the competence to undertake an evaluation of radiographs (Larsson et al., 2013).

For an imaging department to maintain the highest quality standard, an aggressive quality assurance process needs to be implemented. The two main aspects that need to be covered are clinical and machine aspects. Clinical quality assurance aspects include the use of standardised protocols and regular review of rejected films. Machine quality assurance includes quality-control tests and preventative maintenance (Dunn and Rogers, 1998).

Reject analysis has been established as an integral part of the quality assurance process (Clark and Hogg, 2003). Studies have indicated that implementation has resulted in cost-effectiveness; identification of error sources and general improvement of services (Hardy and Persaud, 2001; Lau et al., 2004; Mount, 2016).

The European Union (EU) has developed guidelines on quality criteria for radiographic images. The guidelines aim to improve the quality of radiographs produced and standardise practice (EuropeanCommission, 1996). In this regard evaluation of images should include assessment of; Image annotation, Quality control of X-ray imaging equipment, Patient positioning, X-ray beam limitation, Protective shielding, Radiographic exposure conditions, Screen film system, Film blackening, Radiographic Exposure per examination, Film processing, Image viewing conditions, and Reject analysis.

The commission details the diagnostic requirement for a Posterior-Anterior (PA) chest X-ray in terms of image quality and image details. The image quality criteria should focus on:

- Image symmetry
- Demonstration of anatomy

- Full inspiration (as assessed by the position of the ribs above the diaphragm; either six anteriorly or ten posteriorly and with suspended respiration)
- Medial border of the scapulae to be outside the lung fields
- Reproduction of the whole rib cage above the diaphragm
- Visually sharp reproduction of the vascular pattern in the entire lung, particularly the peripheral vessels
- Visualisation of the retrocardiac lung and the mediastinum
- Visualisation of the spine through the heart shadow
- Visually sharp reproduction of the; trachea and proximal bronchi, borders of the heart and aorta, and diaphragm and lateral costo-phrenic angles

2.7 Radiography training in Zambia

Radiography training in Zambia until 2012 was only through the TEVETA diploma programme offered at Evelyn Hone College. From 1970 to 2013, approximately 450 have graduated (Munsanje, 2014). The diploma programme is overseen by TEVETA. Currently, a degree programme has been introduced at Lusaka Apex Medical University (LAMU).

As noted, the diploma training programme has been in existence for about 45 years. Consultation with TEVETA reviewed that since 1970 the curriculum has only been reviewed four times, this history demonstrates an erratic review process of the curriculum.

According to the TEVETA curriculum development guide, the organisation uses a Systematic Curriculum Instructional Development (SCID) approach. This approach is used to develop competency-based curriculum and instructional materials using a five-step process of; curriculum analysis, curriculum design, instructional development, training

implementation, and programme evaluation. TEVETA uses an expert panel approach for determining job requirements and not necessarily an actual WBA (TEVETA, 2010).

2.8 Radiography practice in the Zambian health care system

The scope of health service delivery in Zambia comprises promote, preventive, curative and rehabilitation care, which is provided at various levels, from the community, up to tertiary hospital level of care. This hierarchy also determines the structure of the referral system, aimed at ensuring the continuum of care. The health services in Zambia has a pyramid area-based structure, with the provision of basic health services in lower health facilities, i.e. Health Posts and Health Centres, covering a limited geographical area, supported by the first, second and third-level referral hospitals, through an established referral system. Radiology services at these levels are defined. However, basic services are expected at level 1 (GRZ, 2017).

A study conducted in Zambia on the role extension as a solution to the critical shortage of radiologist indicates the current curriculum may need to be reviewed to allow for new clinical competencies to be included (Munsanje, 2014). As part of the study, short training was conducted, which showed an improvement in the quality of imaging and acceptability of the idea of a role extension.

While there is agreement that regular curriculum review is a must in ensuring that concordance exists between radiographer training and contemporary radiographer job requirements in Zambia, the review process has been erratic and has not usually employed information from the assessment of graduates in the actual practice. Prideaux (2003), notes that critical links exist in a tripartite relationship of the curriculum, students and health service communities. It is necessary to have input from the health services communities in ensuring

that the curriculum used in training meets the contemporary requirement for practice. Therefore, the link between graduate's performance in the work environment and the curriculum is critical if the curriculum is to remain relevant to contemporary times. Generating evidence of how WBA can contribute to this process is thus justified.

2.9 Conceptual framework

In order for a curriculum to respond to the contemporary requirements for modern practice, a regular and thorough review must be undertaken. Apart from this, it is essential to acknowledge that several other factors may play a role in the successfulness of a curriculum. These factors include; training (resources and assessment practices), Legal and professional factors (Workplace requirement, practice changes, and experience), and changing trends for practice. This conceptual framework is shown in Figure 2.7.

2.9.1 Training factors

In assessing the impact of training factors, two of the many considerations that must be made are the assessment practices and resource requirement. The assessment has been found to be extremely profound in what students eventually learn. The assessment practices convey to the learners what teachers consider to be important (van der Vleuten et al., 2012; Manogue et al., 2002; Hays, 2008; Epstein, 2007; Downing and Yudkowsky, 2009; Bloxham and Boyd, 2007; Amin et al., 2006). When properly aligned with the expected competencies, assessment can help to evaluate if the intended outcomes have been attained. Therefore, a training system or programme that fails to match the competency outcomes with assessment practice may eventually graduate incompetent individuals (Norcini et al., 2011).

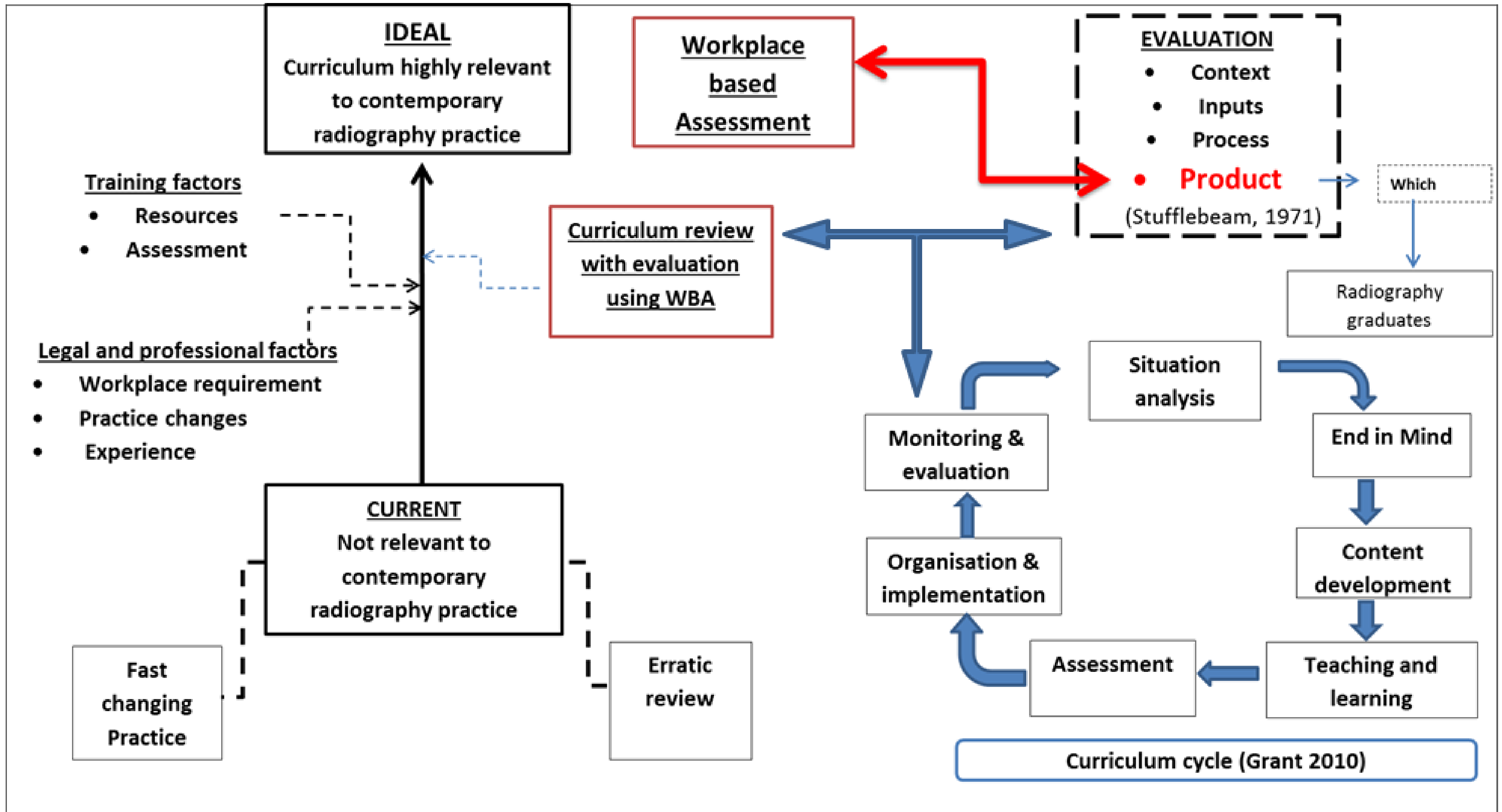

Figure 2.7: Conceptual framework

Salas et al. (2009) explored the cornerstones to successful training of a team. They concluded that success factors include; alignment of training and institutional objectives, providing organisational support for training, including frontline staff in the decision-making process, ensuring that environment is adequate for training needs, ensuring that financial resources and time are adequately provided for, and ensuring the availability of appropriately trained personnel. These factors are aligned with the resources indicated in the conceptual framework for the study.

2.9.2 Legal and professional factors

The practice of health professionals in Zambia and across the world is highly regulated by statutory and professional bodies. These bodies determine the minimum requirement for practice. These also determine the scope of practice (Williams, 2006; White and McKay, 2002; Price and Edwards, 2008; GRZ, 2009; Eddy, 2008). Such rules are essential in establishing competency requirement for training and as such can be used as a benchmark for assessing the competence of a practitioner.

2.9.3 Changing trends for radiography practice

In the recent past, there has been a tremendous change in the field of medical imaging (Sloane and Miller, 2017; Cowling, 2008). These changes have resulted in a need to upscale the competency level of radiographers so that they remain attuned to the practice requirements (Björkman et al., 2017).

These changes have been with respect to changing technologies (Campbell et al., 2019) and the demand for extended roles (Cascade et al., 2001). In terms of technology, the advent of computerised systems has such as Picture Achieving and Communication System (PACS) and computerised based imaging system now demands that radiographers are equipped with Information Communication Technology (ICT) skills (Campbell et al.,

2019). On the other hand, the increased demand for imaging services has resulted in an overburdened healthcare system that requires radiographers to perform none traditional functions such as film reporting (Björkman et al., 2017).

2.9.4 Role of curriculum review in improving outcomes

It has been established that a curriculum requires to be reviewed frequently to ensure that the contents speak to contemporary requirements. A curriculum circle of five (5) years has been suggested (WFME, 2015). The curriculum process, as highlighted, has several components, one of which is the evaluation.

The point of entry for the study into the already established body of knowledge around curriculum review is that the evaluation of the curriculum must be informed by the context as advocated in the Skilbeck's model of curriculum design. In the evaluation process, an examination of the products as advocated for by Stufflebeam's CIPP model is critical to the establishment of a curriculum that fits the contemporary requirements. Whilst most curriculum reviews utilise experts, the assessment of the products of the programme can be a valuable contribution to the evaluation process.

2.10 Summary of findings from other research studies

A literature search using, Google Scholar, PubMed, Science Direct, and African journal Online did not yield studies that have been conducted with a view of establishing the use of WBA in informing curriculum development practices in radiography or other medical fields. Most publications were limited to research in the use of WBA for students either at undergraduate level or postgraduate, especially in the training of medical doctors. Evidence of use of WBA on an already qualified individual for the purpose of improving curriculum was not found.

2.10.1 Usefulness and acceptability of WBA

Several studies have been undertaken to evaluate the use and acceptability of WBA. The outcomes of these studies have been varied. Some studies have presented a positive picture, while others indicate the non-acceptance of this method of assessment. Nair et al. (2017) concluded that the use of multiple WBA such as DOPs and Min CEX were suitable for evaluating competencies for foreign doctors seeking to register for practice in Australia. They, however, noted that the assessment types should be carefully selected and the assessors are standardised. This finding is supported by evidence from a study by Moonen-van Loon et al. (2013) who calculated the reliability of using multiple assessment tools to draw a conclusion on the competence of doctors in postgraduate training. They concluded that the tools can be made sufficiently reliable for the stated use.

Acceptability of WBA as a method for assessing medical doctors was also investigated by Nair et al. (2012). They affirmed the notion that WBA is acceptable for both assessors and assessees. This finding was also asserted by Driessen et al. (2012) in their work with final clerkship medical students. Results from a systematic review by Massie and Ali, (2016), show that trainee and trainer perceptions towards WBAs show a contrary view. Massie and Ali (2016), indicate that both assessors and assesses have a negative attitude towards WBA because of; poor understanding as to the purpose of WBAs; insufficient time available for undertaking these assessments; and inadequate training of trainers.

2.10.2 Use of contemporary information to guide curriculum development

One of the objectives of this study was to demonstrate how information from WBA and views of individuals practising would shape the radiography curriculum. A search for similar studies in health did not yield any such research. However, two studies in information communication technology (ICT) education and another in workplace skills for individuals trained for government and academic jobs were found. It must be noted

further that these studies did not use WBA for the generation of information to guide educational changes.

In the first study by Ocholla (2001), data collected from surveys were used to make decisions on the adequacy of existing programmes concerning the ICT contemporary requirements. At the time of publication, they concluded that the content was sufficient to enable student function at acceptable levels immediately post-graduation. This approach validates the use of data collection methods such as surveys to inform curriculum review processes.

In the second stated study by Jang (2016), they used experts to review job tasks for individuals working in the industry in order to identify the skills requirement for individuals. The goal of their study was to identify Science, Technology, Engineering, and Mathematics (STEM) education and required workplace skills in order to bridge the gap between what is taught and job requirements. As with the earlier study by Ocholla (2001), evidence was generated using an evidence-based method to justify educational changes.

2.11 Conclusion

The study sought to establish how WBA of radiographers could contribute to better curriculum review processes. The literature review was undertaken to firstly survey the theories and practices around curriculum development and review, secondly to develop a firm understanding of the context of WBA, and lastly to establish if WBA has been utilised to inform curriculum practices for radiography.

It is evident from the literature that there is an information gap with regard to the use of WBA of qualified radiographer in informing curriculum review processes. However, the theories and concepts of curriculum review and evaluation have been presented.

Secondly, literature pertaining to what WBA and methods of implementation that guided the study development and implementation has been articulated. The competencies for contemporary practice worldwide and precisely the context of radiography in Zambia were explored to allow for the adequate conceptualising of the research problem and research strategy. The next chapter reports the methods and processes undertaken to achieve the main aim of establishing the role WBA can play in informing practices related to improving radiography curriculum design, development, implementation and evaluation.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This study sought to establish how WBA would inform radiography curriculum development practices. The specific objects set were:

i. To establish the contemporary job competencies for diploma radiographers working at the various levels of health service delivery in Zambia.

ii. To analyse the extent to which post-registrations radiographers who graduated from the TEVETA radiographer training programme after 2010 meet the job requirements of a radiographer for primary, secondary, and tertiary care in Zambia.

iii. To evaluate the competency levels of post-registration radiographers who graduated from the TEVETA radiographer training after 2010 in plain x-ray technical sufficiency assessment and correlate with their self-perception.

iv. To establish how the TEVETA curriculum outcomes match the contemporary requirements and actual performance of graduates working in various levels of health service delivery in Zambia.

This chapter outlines the methodology that was used to achieve the above-stated objectives. Initially, reference is made to the conceptual framework in order to create a link between the requirement of the various phases of the study and the set objectives. The overall worldview used to guide the study approach is presented to set the context for the particular study design. Furthermore, an in-depth description of each phase is then presented. In each phase description; the actual method, population, data collection

process, analysis plan, factors that deal with reliability and validity and/or trustworthiness, and finally, the ethical issues are presented.

3.2 Conceptual framework Linkage

The conceptual thinking that was the guiding principle was that the output of any training is invariably linked to the quality of the curriculum. Furthermore, the assumption that the curriculum should be alive to the changes in practice and thus requires regular review must be taken (Harden, 1986). The review process must have a rigorous evaluation process (Woods et al., 2010). An essential evaluation aspect is the quality of the product of the training. Holding the above assumptions, it is therefore important to establish the following; agreement on contemporary requirements for practice, measurement of actual performance, and comparison with the current curriculum. The phases of the study were undertaken to obtain information for each of the aspects before drawing conclusions.

3.3 Research paradigm

The study was rooted in a critical realist paradigm. A critical realist worldview is based on the assumption that a research problem must be resolved using all approaches available (Creswell, 2014). It follows that, if the spectrum of research ranges from a purely quantitative on one side to a purely qualitative side on the other end, then the mid ground can be a blend of both (Creswell, 2014). In this study, this approach was used because of the varied research questions that needed to be answered. Some questions required a qualitative approach, whilst others required a quantitative approach. The amalgamation of the research approaches allowed for the synergy of the strengths while mitigating against the weakness of each method (McKim, 2017).

The use of only a positivist approach (quantitative) would not have been adequate because obtaining consensus on contemporary job requirements for radiographers in Zambia is

firstly an area that has not been adequately researched and secondly, it is composed of varying opinions which need to be considered carefully when obtaining a holistic picture (Creswell, 2014). Furthermore, use of an interpretivist approach only would have made it difficult to obtain an objective measurement of competences of radiographers in question.

The underpinning assumption was that a combination of these approaches provided a more comprehensive understanding of the research problem than either approach would alone (Creswell, 2014). This approach was necessary because contemporary radiography practices needed to be established before utilising these as a basis for the WBA and subsequently comparing these to curriculum state competencies.

The methodological constraints associated with a sequential approach are that the outcomes of one phase must guide the subsequent phases (Creswell, 2014). In a situation such as ours where the qualitative component is a forerunner to the quantitative, it was difficult to design specific components of data collection tools beforehand. Despite this challenge, this approach was adopted because the measurement of technical sufficiency was an area already existing in the curriculum under study. The other qualitative components were used for assessment of the adequacy of the curriculum under review.

3.4 Overall research design

The specific mixed-method approach used was the sequential exploratory design. A sequential mixed-method approach is a mixed-method approach in which both the quantitative and qualitative components both have a significant contribution to the overall outcome. The exploratory nature stems from the fact that the area under study is not well researched and thus requires a qualitative aspect to be investigated first before the quantitative component (Creswell, 2014).

The study was conducted in a multiphase approach as shown in Table 3.1. This allowed for information gathered in one phase to be used in the subsequent phases. In investigating how WBA could be implemented in curriculum review to ensure a curriculum that was meeting contemporary requirements the following was undertaken; Establish the contemporary requirements, Analyse perception of performance against these requirements, Conduct an actual assessment of to determine the level of actual performance, and Compare actual performance to stated curriculum outcomes.

Table 3.1: Outline of the study phases aligned to objectives and selected data collection method

Phase	Objective	Method used
Phase I	Establish contemporary job competencies	Qualitative survey using a Delphi technique
Phase II	Consensus on job competencies and establish perceived competencies	A qualitative approach using FGDs
Phase IIIA	Established self-perception of competency	Non-experimental, Descriptive and Cross-sectional study using self-administered questionnaire
Phase IIIB	Measure actual competency and compare to self-perception	WBA
Phase IV	Evaluate curriculum and compare actual competency to stated curriculum competencies	Desk review

3.5 Description of Phase I

The objective of the first phase was to build consensus on contemporary job requirements of a radiographer working in the Zambian healthcare setting. A qualitative survey using a Delphi technique was used. This technique is a group communication process which seeks to draw convergence of experts on a topical issue within their field of expertise

(Hsu and Sandford, 2007). This technique is well suited as a process for consensus-building by utilising a sequence of questionnaires delivered using multiple iterations to collect data from a panel of selected participants. The Iterative process interspersed with feedback distils the judgments of experts (Skulmoski et al., 2007).

The number of iterations made in this study was two (2). It was agreed to cease at two iterations because the initial list of competencies generated was then subjected to further FGDs in the second phase of the study. The second questionnaire was modified based on the responses from the first iteration (see Appendices 1 and 2). In our case, the aim was to obtain the consensus of radiographer job competencies. The process stopped when no new competencies were suggested.

The drawback with a Delphi technique is that in some cases several iterations have to be made in order to ensure consensus. This can be a limiting factor when the study time is limited (McKim, 2017). Furthermore, subject selection, the possibility of low response rates, and unintentionally guiding feedback from the respondent group also poses a challenge for such a process (Skulmoski et al., 2007).

In this study, this limitation was mitigated by using FGDs as a follow up to the Delphi technique; this allowed for the further in-depth probing of the initial list of competencies. Furthermore, the participant selection allowed for a variety of participants with an in-depth understanding based on their experience as radiographers working in Zambia.

The focus for consensus was around three thematic areas; radiographer description, contemporary competencies, and future competencies. This is illustrated in Figure 3.1 below. The contemporary competencies relate to job profiles requirements required to satisfy present day regulations and professional demands. The future competencies on the other hand relate to areas of possible role extension.

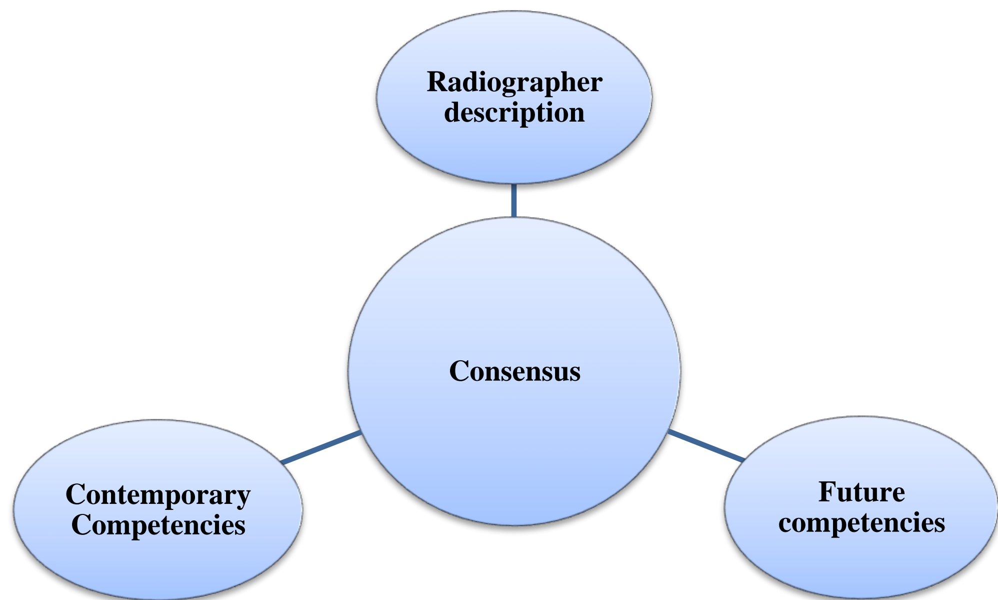

Figure 3.1 Phase one thematic areas

3.5.1 Phase I Study setting

Informants for this phase of the study were drawn from all the ten (10) provinces of the country. The objective was to widen the consultative process when arriving at the contemporary job requirement or competences for a radiographer working in Zambia.

3.5.2 Phase I Study population and sampling

The population for this phase was experienced radiographers working in Zambia. The specific inclusion criteria were:

- Radiographers with at least ten years' work experience in medical imaging departments or radiography teaching institutions in Zambia
- Radiographers involved in training and clinical supervision (tutors, lecturers, curriculum developers & practising radiographers)

A purposive sampling approach was utilised. The individuals were identified through consultations with the Secretariat of the Radiological Society of Zambia and Ministry of Health Chief Medical Imaging office. These offices keep a database of all radiographers practising in Zambia. Furthermore, the researcher is a radiographer with over twenty (20)

years’ experience and has close working relations with both clinical and academic radiography units across the country. This insight allowed for the selection and close follows up of participants to ensure feedback.

Saturation guided the attainment of a sample size. In the first circulation, a total of 40 questionnaires were distributed with a return rate of 75% (n=30). In order to increase the coverage, a total of 50 were distributed in the second round with 86% (n=43) return rate. It must be noted that the number of respondents from the first round who participated in the second round was 28. The distribution of the respondents was; Lusaka N=18(42%), Copperbelt N=4(9%), North-WesternN=3 (7%), Western N=3 (7%), Southern N=3 (7%), Eastern N=3 (7%), Central N= 3(7%), Luapula N=2 (5%), Muchinga N=2 (5%) and Northern N=2 (5%). The goal was to obtain representation from all the provinces and teaching institutions.

3.5.3 Data collection for phase 1

A questionnaire with a proposed description of radiographer and competencies (appendix 1) modified from the Williams and Berry (1999) was initially circulated. The distribution methods included physical delivery and emails subsequent to a telephone discussion in which an appointment was made or an explanation of the process for informants not in Lusaka.

The questionnaire initially comprised of a demographic section, radiographer description, and a list of competencies (see Appendix 1). A preliminary definition of a radiographer was provided to the participants to the critic. This definition was “The primary role of a radiographer is to produce high-quality diagnostic images with due consideration of the needs of the patient.” Participants were asked to rate their agreement with the above description using a scale of 1 to 10. The ranges from 1 to 3 indicated a low agreement

level, whilst the ranges from 4 to 6 related to a moderate agreement level. The last range of 7 to 10 represented a strong agreement with the description.

Furthermore, the study participants were provided with a list of job roles and responsibilities. This list comprised the following categories; Professional, Clinical, Interpersonal, Patient care, Technical, Administrative, and Theoretical. Participants were asked to suggest additional categories.

The respondents were requested to provide agreement with the statement using a scale of one (1) to ten (10), with one (1) indicating least approval and ten (10) the highest approval. Furthermore, participants were requested to provide their thoughts, alternatives and additions concerning proposed competencies.

The responses from this circulation were analysed. A new questionnaire based on the recommendation was synthesised from the responses (Appendix 2). The variation in the structure was mainly related to the inclusion of new competencies. Just as in the first iteration, respondents were asked to express their views with regard to acceptance or declining of the proposed job competencies for radiographers working in the Zambian Health sector. Analysis of the second circulation resulted in the consolidation of a list of contemporary competencies and proposed future roles of radiographers working in Zambia. The synthesised information was used to generate job requirements that were used in the second phase of the study.

3.5.4 Data analysis for Phase 1

The analysis utilised both content and thematic approaches. This combined approach was used because participants were required to agree on suggested themes and propose new categories with regard to contemporary competencies of radiographers in Zambia. The completed questionnaires were transcribed. Reoccurring themes were coded for new proposed categories. The coding sequence included; opening coding (characterisation of

information), Axial coding (the relationship between the emerging themes), and finally selective coding which include identification of the main themes. With regard to an agreement on proposed themes, participant's views were analysed by aggregating similar responses. The process of analysis was aided by the use of software Nvivo version 11. Apart from qualitative aspect, proportions were also used to report some of the findings.

3.5.5 Trustworthiness

In this phase of the study, the specific threats to trustworthiness identified included; the use of a questionnaire, misinterpretation during data analysis, and a limited number of iteration to allow for a thorough review and conclusions. The Table 3.2 below outlines these threats and the strategies used to minimise their effects.

Table 3.2: Validity and reliability strategy

Phase	Specific Threat	Intervention
Phase 1	Validity and reliability of the Delphi questionnaire	Use of a tool that has been tested in the collection of similar information by William and Barry 1999
	Misinterpretation during Data analysis	Using an iterative approach of going to and fro to the participants will eliminate misinterpretation
	Limited iteration	Use of subsequent methods such as FGD to supplement

3.6 Description of phase II

This phase sought to explore the perception of Zambian radiographers with respect to performance against the agreed job requirements. FGDs were conducted to elicit the perceptions of radiographers. The use of FGDs in qualitative studies is well accepted because of the ability to allow for in-depth probing of a discussion item by experts. One

strength lies in the ability to seek immediate clarification or focusing on issues that would normally be left out (Redmond and Curtis, 2009). This phase generated qualitative data that provided an overview of the competence list generated in phase I and a global rating of radiographer performance. The outcome was targeted at generating answers to the second research question.

One challenge associated with FGD is the securing of a convenient time and place for the discussion to be held. This was a particular challenge for the Copperbelt FGD where participants were required to move from other towns to Ndola to participate in the FGD. To ensure, adequate attendance, those travelling from outside town were re reimbursed their travel expenses. Furthermore, meticulous plan for the venue and time were undertaken.

3.6.1 Study setting

The selection of Lusaka and Copperbelt as study sites was based on the fact that these are the provinces with the largest number of radiographers and furthermore, most of the hospitals in these provinces are used as clinical practice sites by the training institutions. The specific sites used for the discussions were; Cancer Diseases Hospital (CDH) for the Lusaka province radiographers and Ndola Teaching Hospital (NTH) for the Copperbelt province radiographers. These specific sites were selected because of their ease of accessibility.

3.6.2 Population and sampling for Phase II

The population was similar in characteristics to that from the first phase. The specific inclusion criteria were:

- Radiographers with at least ten years' work experience in medical imaging departments or radiography teaching institutions in Zambia

- Radiographers involved in training and clinical supervision (tutors, lecturers, curriculum developers & practising radiographers)

As with the first phase, a purposive sampling approach was utilised, although it was restricted to those participants within the selected provinces (Lusaka and Copperbelt). The researcher used his experience and knowledge of the prospective participants to select the participants. The researcher has been in radiography practice and teaching for over 20 years and has worked in the Ministry of Health and is a past president of the Radiological Society of Zambia. These factors provided a reasonable basis for selection by the researcher. The underlining goal was to obtain participation from clinical, academic and administrative components of radiographic practice in Zambia.

Two FGD were planned and conducted. Following the principle of constant data comparison following each FGD, it was noted that there were significant similarities in the response from the two FGD that warranted a stop to further interviews as guided by the principle of data saturation (Creswell, 2007).

A total of seventeen (17) individuals participated in the two FGDs. The Lusaka FGD had a total of ten (10) participants. The FGD conducted in Lusaka had participants drawn from, training institutions, public and private clinical facilities, and administrative portfolios. The Copperbelt FGD mostly comprised of clinical personnel from three major hospitals (Ndola Teaching Hospital (NTH), Kitwe Teaching Hospital (KTH) and Arthur Davison Children Hospital (ADCH)). The selection of participants from two provinces was undertaken because, these were the provinces with the majority of training sites in the country.

3.6.3 Phase II data collection

The first FGD was conducted in Lusaka, followed by the one in Ndola. Explanation of the study and appointments were initially secured by phone. Those that accepted to participate were sent the developed job requirement for review before the discussion. The central questions in the FGD focused around:

- Perceptions concerning job requirements developed in the earlier phases
- Performance of radiographers with regard to the job requirements

Prior to the start of each FGD, the researcher greeted and provided an overview of the study before obtaining consent for the recording of the discussion. Each of the FGD took approximately one (1) hour. The interview guide in appendix 3 was used. During the interview, participants were asked additional questions to seek clarification for some of the issues discussed. These discussions were audiotaped for review and analysis. At the end of each discussion, the researcher thanked all present.

3.6.4 Data analysis for Phase 1I

The analysis for this phase of the study was conducted using thematic analysis. During the analysis, the organised data was reduced into themes through a process of coding and condensing the codes. Finally, emerging information presented as a discussion (Creswell, 2007). Coding is a process that has two activities done simultaneously: mechanical data reduction and analytic categorisation of the data (Neuman, 1997).

The analysis began with listening to the audiotapes and then transcribing the verbatim discussion. In the initial coding (open coding), the phenomena were identified, named, categorised and described. This was done by going through the verbatim record and writing down codes that were aimed at characterising important information (Dahlgren et al., 2004).

In the initial coding (open coding), no deliberate effort was made to link the emergent themes. In the axial coding phase a relationship between the emerging themes was established through a combination of inductive and deductive thinking. The emphasis at this stage was on the codes from the open code and not the primary data (Neuman, 1997).

The last phase of the coding process involved the scanning of data and previous codes. In the selective coding phase one category was chosen to be the core category, and all the other categories were then related to this core category (Creswell, 2007). The software Nvivo version 11 was used for data management.

The final themes were then presented to a qualitative researcher to confirm the themes. This peer debriefing process allowed for further clarification and thoroughness of the analysis process.

3.6.6 Trustworthiness

The main threats to trustworthiness for the second phase of the study was; use of non-rich informants and misinterpretation of the findings. The Table 3.3 below outlines these threats and the interventions used to reduce the effects of the threats.

Table 3.3: Validity and reliability strategy for phase II

<table>
<tr><th>Phase</th><th>Specific Threat</th><th>Intervention</th></tr>
<tr><td rowspan="2">Phase 2</td><td>Missing out of data by a selection of none rich informants</td><td rowspan="2">Use of two FGD allowed for a refocusing of participant selection in the second FGD
Using a peer review process of the findings</td></tr>
<tr><td>Misinterpretation of the findings during the analysis</td></tr>
</table>

3.7 Description of phase III

In this phase of the study, a census approach was used, and the total number of participants was 31 participants. This phase had two (2) sub-elements. The first was a self-evaluation of competence and the second the actual evaluation using WBA. The perception of radiographers concerning performance against the technical requirement for film requirement evaluation was tested first. The actual performance was then measured using WBA. A comparison was then made between manifest competence and perceived competence.

This was undertaken using Non-experimental, Descriptive and Cross-sectional approach using a self-administered questionnaire and a WBA focused on chest radiograph evaluation for quality.

It was anticipated that using such a design, especially for the WBA would be a challenge because no literature had been found that suggested the method of achieving the objective as stated in the study. In this regard, it was essential to pilot the tools for this aspect of the study before using them in the data collection process. To this effect, a pilot study using radiographers at UTH and CDH who were not eligible to take part in this phase of the study was done. Slight modifications were done to the data collection tool. This included the adjustment of the Likert scale (See appendix 4 and 5).

3.7.1 Study setting for phase III

There were four Hospitals used for this phase of the study. These included; CDH, University Teaching Hospital (UTH), Ndola Teaching Hospital (NTH), Arthur Davison Children Hospital (ADCH), Kitwe Teaching Hospital (KTH) and Chipata Teaching Hospital (CTH). The selection of Lusaka, Ndola, Kitwe and Chipata as study sites was based on the fact that these are towns with the largest number of radiographers and

furthermore, most of the hospitals in these towns are used as clinical practice sites by the training institutions.

3.7.2 Population Phase III

The population was radiographers working in government hospitals. The specific inclusion criteria were:

- Radiographers in practice who graduated after 2010
- Work experience of less than six (6) years

All radiographers in the selected hospitals were included. Hence a census approach was used because of the relatively small number of the population (estimated population was less than 50).

A count of radiographers fitting the inclusion criteria showed the actual number was about 40. The number who participated was 31. This represented 77% of the targeted population. Difficulties in accessing all possible participants were hampered because of conflicting schedules. Some of the potential participants were on leave during the time set for data collection.

3.7.3 Data collection Phase III

Arrangements for the data collection were made through the offices of the radiographer in charge. The researcher conducted the data collection for all the sites. Data collection in each hospital was scheduled for two days. The first day was earmarked for debriefing, consenting and completion of the questionnaire. The second was set for the WBA.

3.7.3.1 Phase III A

A non-experimental descriptive cross-sectional study design was implemented using a questionnaire (see Appendix 5). The questionnaire was distributed to radiographers fitting the inclusion criteria working the selected hospitals. Each participant was given a

thorough explanation of their requirements for responding to the questionnaire. After the questionnaire was completed it was retrieved, appropriately labelled and packaged to await analysis. The questionnaire was divided into the following sections,

- Demographics
- Clinical experience
- Self-rating of competence in film evaluation
- Criteria for evaluation of images

The focus of the questionnaire was to obtain a picture of their practice environment and objectively measure self-rated competence in the area of film evaluation for quality. To establish the participants' exposure to the range of examination performed in the departments, they were asked to specify the number of such examinations performed by them weekly. The sites included; Chest, Abdomen, Pelvis, Spine, Skull, Upper Limb, and Lower limb. The frequency was scored using five (5) levels; less than 5, between 5 and 10, between 10 and 15, between 15 and 20, and over 20 per week).

The areas of focus on the film evaluation included; anatomy coverage, patient positioning, film exposure, film contrast, image sharpness, identification requirement, and radiation protection measures. In each of these categories, the participant was given a five (5) point Likert scale to use for the self-rating. The rating was; 5: Excellent, 4: Very good, 3: Good, 2: Moderate, and 1: Poor. The implication was that a score of excellent denoted the highest proficiency while poor denoted the lowest competence. A summed score was used as an aggregate determinate of overall competence rating.

3.7.3.2 Phase IIIB

A technical sufficiency WBA in the area of quality evaluation of chest radiographs was implemented in this phase. This assessment was developed using the European Commission standard for chest x-ray quality evaluation (EuropeanCommission, 1996).

The researcher selected five chest x-rays from the UTH teaching library (Figures 3.1 to 3.5).

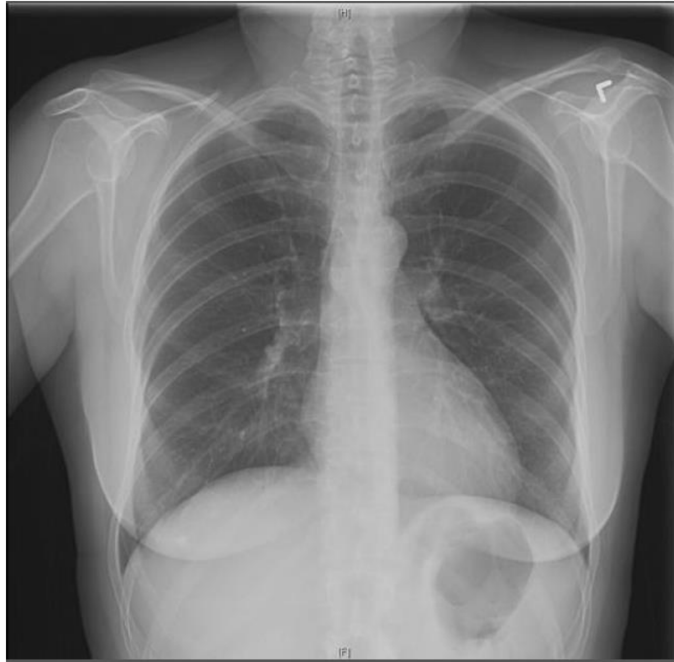

Figure 3.2: Image 1

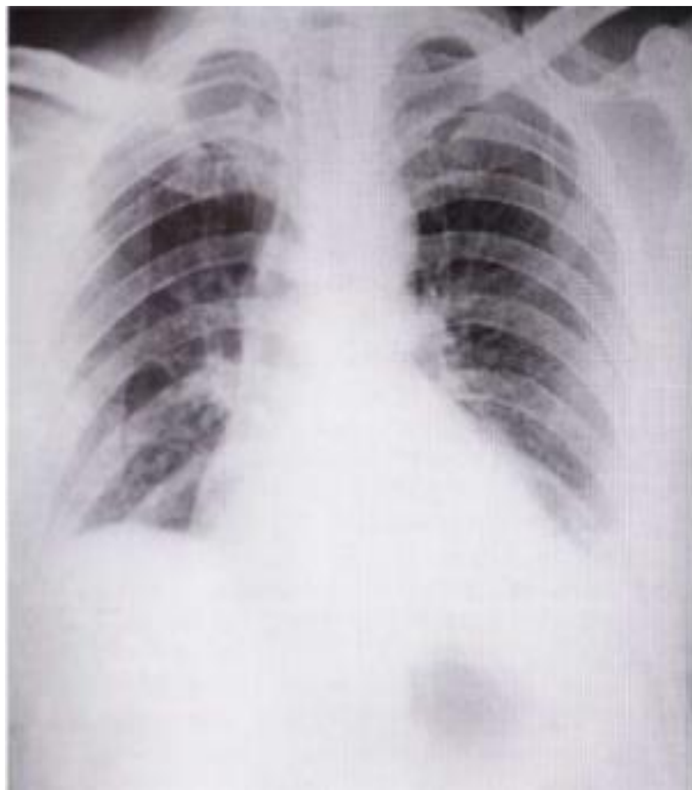

Figure 3.3: Image 2

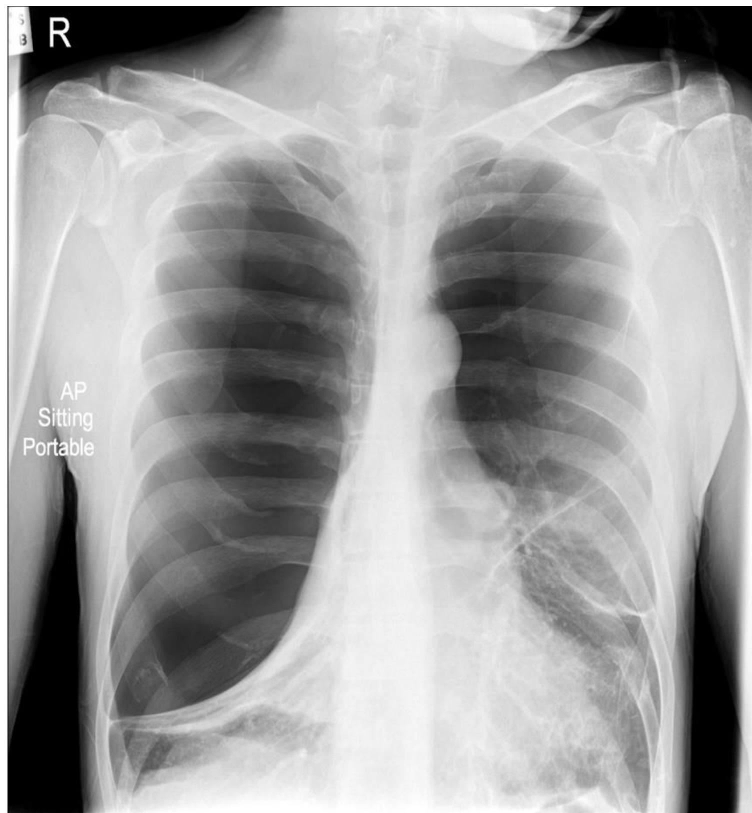

Figure 3.4: Image 3

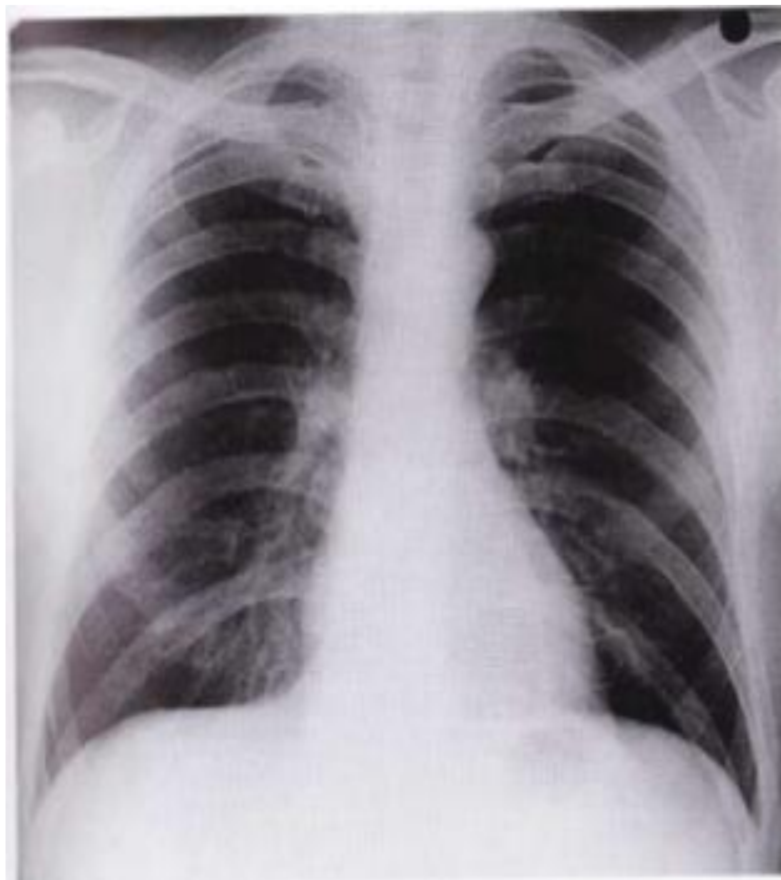

Figure 3.5: Image 4

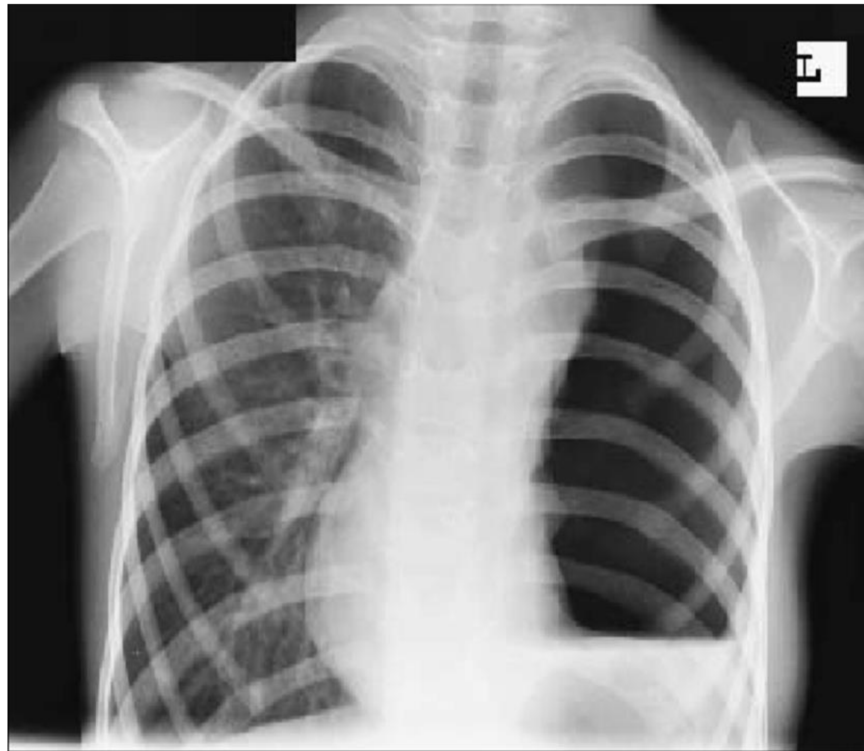

Figure 3.6: Image 5

Two experts were purposefully selected to evaluate the five images. The criteria for expert inclusion were;

a. Over ten years' experience in clinical practice at the level of at least senior radiographer
b. Teaching experience in clinical, radiographic technique for at least five years
c. Postgraduate qualification at the level of masters in diagnostic radiography

The framework used for image evaluation is shown in the Table 3.4 below.

Table 3.4: Showing criteria for evaluating chest x-ray for technical sufficiency

No	Factors	Criteria
1	Anatomy coverage	a) Reproduction of the whole rib cage above the diaphragm b) Performed at full inspiration (as assessed by the position of the ribs above the diaphragm either six anteriorly or ten posteriorly) and with suspended respiration c) The costophrenic angles and diaphragm outlined clearly.

		d) The fine demarcation of the lung tissues shown from the hilum to the periphery. e) at least the two last cervical vertebrae (C6 & C7)
2	Patient Positioning	a) The clavicles symmetrical and equidistant from the spinous processes and not obscuring the lung apices. b) Full lung fields with the scapulae projected laterally away from the lung fields.
3	Exposure	a) Visually sharp reproduction of the vascular pattern in the whole lung, particularly the peripheral vessels b) Vertebral bodies faintly visible through the heart shadow c) Ribs faintly visible behind the heart
4	Contrast	a) Small details in the whole lung, including the retrocardiac areas: b) Linear and reticular details out to the lung periphery:
5	Sharpness	a) The mediastinum and heart centred and defined sharply. d) Visually sharp reproduction of; trachea and proximal bronchi, borders of the heart and aorta, and diaphragm and lateral costo-phrenic angles
6	Image annotation	a) Patient identification (name and unique numerical identifier) b) Date of examination c) Positional markers d) Name of the facility e) Radiographers identification The above should not murk the diagnostically relevant regions of the radiograph
7	Radiation protection	a) Limiting the X-ray beam to the smallest field, giving the required diagnostic information. b) Limitation of the radiation beam should also consider the need to exclude radiosensitive organs from primary irradiation whenever possible. c) On no occasion should the X-ray beam fall outside the image receptor area. d) It is desirable for there to be evidence on the radiograph of beam limitation.

The rating was initially done by each expert separately using the framework in the table above. Following this, a discussion between the experts was held to arrive at the final rating under each category. Competence was judged to be plus or minus two (+/-2) of the average score (Jackson, 2007). The Table 3.5 below depicts the scores from the experts which were used as a standard score for evaluation of the radiographers.

Table 3.5: Showing the correct score and acceptable competence range for each image

Factors	Score for each image					Total	Competence range (-/+2)
	1	2	3	4	5		
Anatomy coverage	5	1	5	4	2	17	15-19
Patient Positioning	5	1	5	5	2	18	16-20
Exposure	5	1	5	5	5	21	19-23
Contrast	4	1	5	4	5	19	17-21
Sharpness	5	1	5	4	5	20	18-22
Image annotation	1	1	2	1	1	6	4-8
Radiation protection	3	1	5	5	1	15	13-17

The ratings of the images by the experts were used as a baseline for comparison in the WBA for the participants. During the WBA, participants were provided five (5) Chest X-rays to evaluate for technical sufficiency. The same images were used across all the sites. For each of the images participants were requested to rate the technical adequacy on a scale of 1 to 5 of each film in the following areas; Anatomy coverage, Patient positioning, Film exposure, Film contrast, Image sharpness, identification requirement, and Radiation protection measures.

3.7.4 Data analysis

3.7.4.1 Phase IIIA

The outcome of this phase was a quantitative evaluation of self-perception. The data was analysed using measures of central tendency and dispersion. Data that were normally distributed were summarised using mean and associated standard deviation. While median and interquartile ranges were used for none normally distributed data. Data were tested for normality using the Shapiro-Wilk test with alpha set at 0.05. Proportions were also used to summarise agreement with suggested contemporary competencies. Comparison of performance used a Kruskal-Wallis test and a post hoc test using Dunn multiple comparisons with significance set at $p<0.05$.

3.7.4.2 Data analysis Phase IIIB

The performance of the participants was aggregated with competence set at +/- 2) of the score (Jackson, 2007). A Kruskal-Wallis test was used to compare the performance of participants across the images. For normally distributed performance score, a simple'‘t' test using the expert score as hypothetical mean was used. For none normally distributed scores, the Wilcoxon signed-rank test was used. Furthermore, Fisher's exact test was conducted to compare performance between self-assessed competence and measured competence from WBA.

To assess overall performance, a Kruskal-Wallis test was used to compare across all domains (anatomy coverage, contrast, exposure, sharpness, radiation protection, image annotation and patient positioning). Furthermore, Fisher's exact cross-tabulation was performed between various variables and competence outcome. A correlation was also performed to identify factors with significant correlation. Multilevel regression was also performed to establish explanatory variables.

3.7.5 Validity and reliability

Severally validity and reliability issues primarily arose from the use of tools not tested. To address these, piloting of the tools was done to ensure internal consistency. Furthermore, the WBA tool was also subjected to scrutiny and comments by the Medical Education Department. Another matter that was considered was the low return rate from the initial phase. This was addressed by the researcher waiting for the participants to complete the forms and selecting an appropriate time for the data collection.

3.8 Description of phase IV

This phase was a desk review that involved an evaluation of the current TEVETA radiography curriculum content, outcome and assessments. This was achieved by conducting a curriculum mapping process. In a curriculum mapping process, the competences, teaching methods and content are summarised and enumerated (Appendix 12). The similar aspects are then grouped and quantified. Such an analysis helps to evaluate the concentration or focus of the curriculum (Harden, 1986; Harden, 2001).

Furthermore, this process included analysis of the agreed job requirement, perceived performance and actual performance. The significant validity and reliability issue was the likelihood of omission of critical information during the process of the curriculum. A second check of the derived data was done by an independent expert from the department of medical education.

3.9 Ethical issues

The following were the ethical issues considered in this study; informed consent, anonymity, confidentiality and benefits (Creswell, 2007). The study was approved by ethics committees of the Universities of Zambia biomedical research ethics committee

(Approval 012.06.17). Furthermore, authority was obtained from institutions where the data collection was to be conducted (CDH, NTH, KTH, ADCH and CTH).

The next consideration was participant informed consent. In all the phases of data collection, the aims, methods, possible benefits and issues of confidentiality were explained to the participants verbally and in writing. The participants were informed of their right to seek clarification. Those who were willing to participate in the study were then requested to sign consent forms.

The anonymity of the participants was ensured by not using any of the patients' names in the analysis and reporting phases. Confidentiality of the identity and performance of individuals in the WBA was also maintained by utilising answer scripts that had no requirement for personal identification. In addition, the audiotapes and field notes were kept locked in a drawer in the investigator's office. Participants were also informed that no direct benefit would accrue to them, and that the study would not in any way prejudice their work activities.

The researcher's responsibility to ensure professional conduct included:

- referencing and acknowledging materials from other scholars
- presenting the facts as obtained from the participants
- not coercing the participants
- commitment to the publication of findings of the study

3.10 Conclusion

This chapter reports the methods utilised in the data collection process. It further highlighted the alignment between the objectives and the methods to attain them. The next chapter details the findings from the analysis of the data collected.

CHAPTER 4 PRESENTATION OF FINDINGS

4.1 Introduction

The main research question that guided the study was 'How can workplace performance assessments inform curriculum development and attendant assessment practices in order to improve concordance of radiographer training and job requirements of contemporary radiographers who graduated after 2010 from the TEVETA training programme?' The core element was to evaluate the value of using WBA on graduates to ascertain their competency levels and link these to specific curriculum outcomes with a view of improving curriculum design practices. In the background, it was also hoped that current practice requirements for radiography practice in Zambia would be established to compare it to manifest competencies and specified curriculum competencies.

This chapter outlines the findings of the study. Notwithstanding the fact that data was collected in chronological order beginning with establishing consensus on contemporary practice, establishing perceived competency level, measuring competence, and finally evaluating the curriculum, results presentation for the core theme are reported first. This approach is taken to ensure that the core question is answered and emphasised. In this regard, findings from phase 3 presented first and then those from phase 1, 2 and 4. The last phase (4) ties up all the other three phases.

4.2 Self assessed competence and Work-based assessment

This phase of the study was designed to respond to objectives two (2) and three (3) (evaluation of self-competence, measuring actual competency and comparing these outcomes).

4.2.1 Participant demographics and clinical experience

A total of 31 participants took part in this phase of the study. There were slightly more females compared to males (17:14). A total of 17 (55%) qualified in 2015 and 2016. However, only 2 out of 31 had more than 12 months experience in plain film imaging. The mean age was 25 years (Standard deviation 1.63). The Table 4.1 summarises the demographics.

Table 4.1: Showing a summary of the participant demographics for phase 3

Characteristic	Category	Proportion (%)
Hospital	Arthur Davison Children Hospital	5 (16)
	Ndola Teaching Hospital	3(10)
	Kitwe Teaching Hospital	7(23)
	University Teaching Hospital	12(39)
	Chipata Teaching Hospital	4(13)
Sex	Male	14(45)
	Female	17(55)
Year of qualification	2012	3(10)
	2013	9(29)
	2014	2(6)
	2015	7(23)
	2016	10(32)
Period of experience in plan film imaging (months)	12	29(94)
	24	2(6)
	Mean	**SD**
Age	25	1.63

Table 4.2 shows the frequency with which participants undertook various imaging procedures. Chest x-rays, upper limb and lower limb examination, were the most undertaken. This illustrated the number of participants who indicated that they conducted this examination more than 20 times in a week.

Table 4.2 frequency of performing an examination

Examination	Frequency				
	<5	**>5<10**	**>10>15**	**>15<20**	**>20**
Chest X-ray	1		5	3	22
Abdomen	5	4	13	6	3
Pelvis	4	9	11	3	4
Spine	5	10	7	7	2
Skull	4	11	6	4	6
Upper Limb	1		5	2	23
Lower limb	1	2	1	6	21

Apart from Arthur Davison Children's Hospital, most of the participants from the other hospitals indicated that they performed more than twenty (20) chest x-rays per week. The figure below (Figure 4.1) illustrates this.

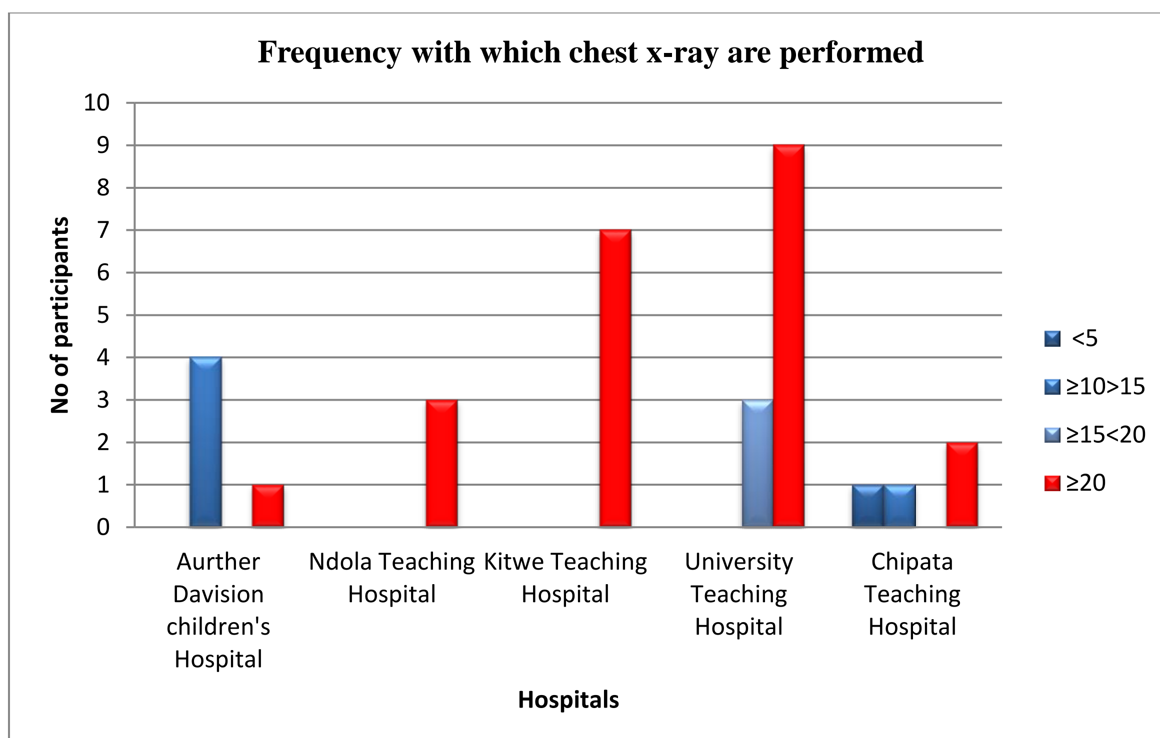

Figure 4.1: Frequency of chest x-ray examination performed per hospital

4.2.2 Results for the self-assessment

The participants were required to perform a self-assessment of their competence regarding their ability to evaluate a chest x-ray quality in terms of; anatomical coverage, positioning requirement, exposure, contrast, sharpness, image annotation and radiation protection. None of the participants rated themselves as poor on any of the above chest x-ray film requirement as shown in Table 4.3.

Table 4.3 Showing participants' self-rating of competency

Assessment criteria	**Proportion of participants**				
	Poor	Moderate	Good	Very good	Excellent
Anatomy	-	3	13	11	4
Positioning	-	2	5	10	14
Exposure	-	2	4	17	8
Contrast	-	2	15	8	4
Sharpness	-	2	19	6	2
Image annotation	-	1	7	8	15
Radiation protection	-	-	5	11	15

There was a significant variation concerning the self-assessment across the different assessment categories. A Kruskal-Wallis test showed a significant difference in the rating across the different categories (p Value<0.0001). A Post-test using Dunn's Multiple Comparison analysis shows that in spite of this overall significant difference, some of the pairwise comparisons did not have a significant difference (Table 4.4).

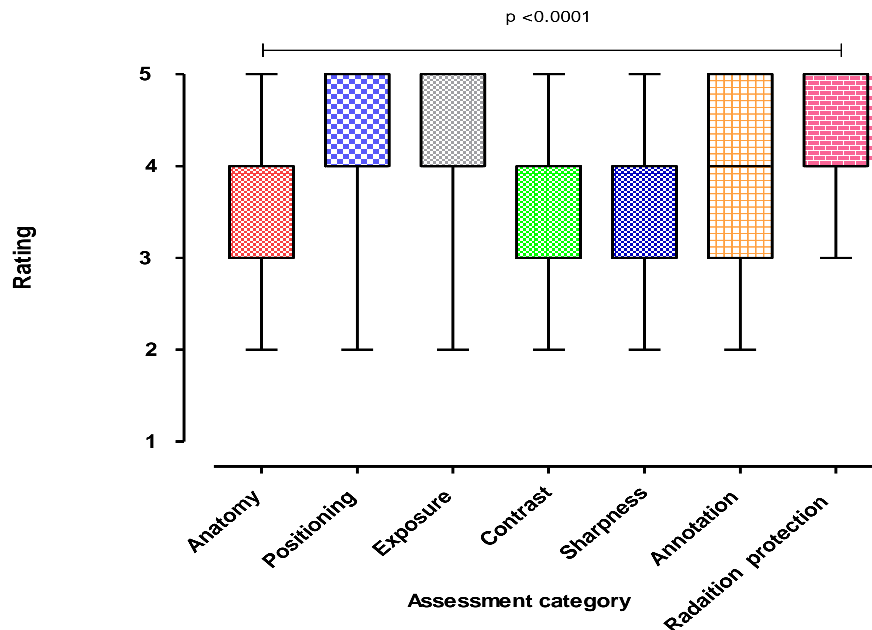

Figure 4.2: Showing participants' self-rating of competence

Table 4.4: Showing a post hoc test for self-assessment of competency

Pairwise comparison	The difference in rank-sum	Significant? P < 0.05?	Summary
Anatomy vs Radiation protection	-52.32	Yes	*
Positioning vs Contrast	51.06	Yes	*
Positioning vs Sharp	64.32	Yes	***
Exposure vs Sharp	53.69	Yes	**
Contrast vs Annotation	-52.32	Yes	*
Contrast vs Radiation protection	-60.4	Yes	**
Sharp vs Annotation	-65.58	Yes	***
Sharp vs Radiation protection	-73.66	Yes	***

p Value obtained using post hoc Dunn's Multiple Comparison test
*** p<0.01, ** p<0.001, ***p<0.0001**

In terms of aggregated self-assessment scores, the mean score out of 35 was 26.77 (SD 4.18). Aggregated anatomy score places the self-assessment performance at good to very good (Mean 3.52 SD 0.85). The median score for positioning, exposure, image annotation, and radiation protection was four (4) which placed the aggregated self-

performance at very good. The aggregated self-assessment performance for contrast and sharpness was rated as of good.

4.2.3 Work-based assessment results

The assessment of technical competence in film evaluation was conducted using five (5) films. Each film was evaluated for quality across seven (7) categories (anatomical coverage, positioning, film exposure, contrast, sharpness, image annotation, and radiation protection). For each of the categories listed an aggregate score across the five (5) images was obtained.

4.2.3.1 Performance on the evaluation of anatomical coverage

The participants' performance is shown in the box and whisker plot (Figure 4.3) below. Rating of anatomical coverage for image one (1) was predominantly high. The opposite was true for image two (2). Images three to five (3-5) had a varied analysis. A Kruskal-Wallis test showed a significant difference in the rating across the different image (p Value<0.0001).

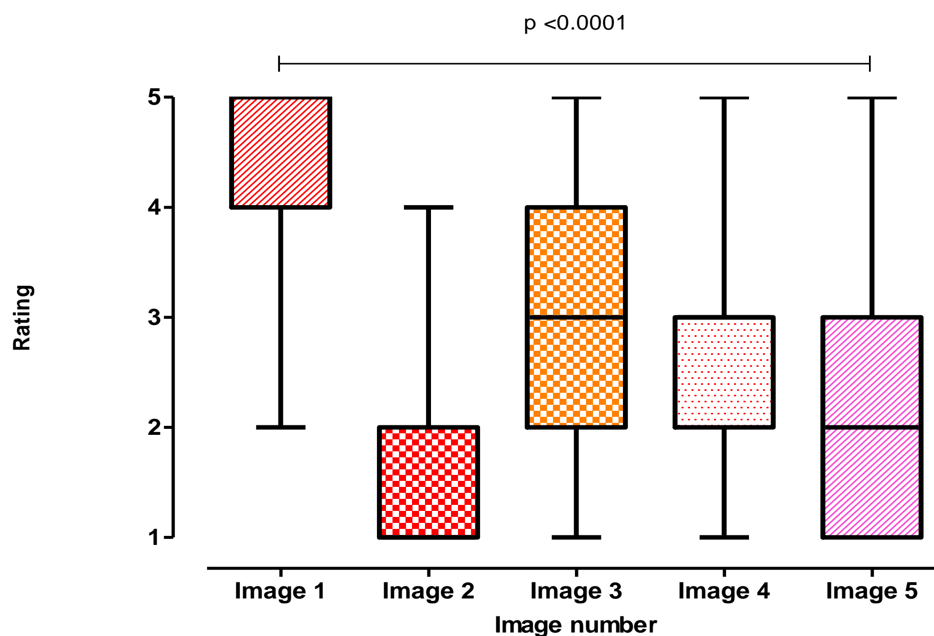

Figure 4.3: Showing participants performance on anatomy evaluation

The standard aggregated score for anatomy was 17 for all the five images. The mean score was 13.97 (SD 3.6). One sample ‘t’ test using 17 as the hypothetical mean showed a significant difference between the actual score and the standard score ($p < 0.0001$) as depicted in Figure 4.4.

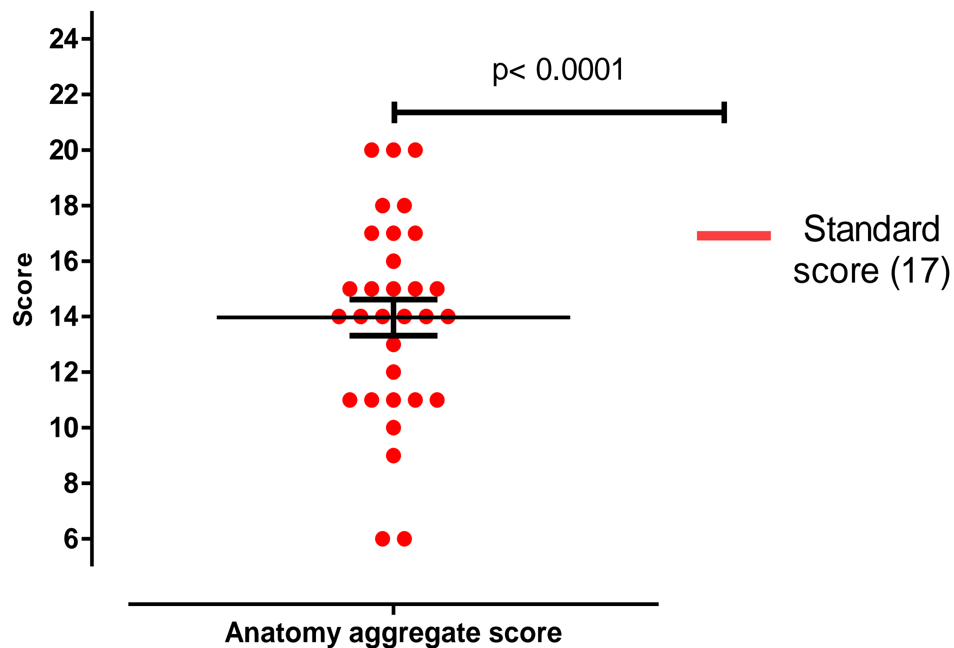

Figure 4.4 Showing performance of participants’ on anatomy evaluation

When competence was analysed, 20 (65%) of the participants were assessed as not competent in their ability to evaluate anatomical coverage of an image correctly. Further analysis performed was a comparison between self-assessed competencies in anatomy evaluation against actual competence score. It was noted that of the participants who rated their competence performance at 2 or 3 constituted 6 out of the 11 (55%) who were found competent in this category. When Fisher’s exact test was performed, there was no significant difference among the individuals ($p = 0.243$). Hence no association could be ascertained between self-evaluated competence in anatomy evaluation and actual performance in the WBA. This is summarised in Table 4.5 below.

Table 4.5: Self-assessment Vs actual competence in anatomy evaluation

Self-assessed competence	Anatomy competence		Total	p-Value (Fisher's exact test)
	Not competent	**Competent**		
2	2 (67%)	1 (33%)	3	p= 0.243
3	8 (62%)	5 (38%)	13	
4	9 (82%)	2 (18%)	11	
5	1 (25%)	3 (75%)	4	
Total	**20**	**11**		

4.2.3.2 Performance on the evaluation of patient positioning

The second category for assessment was the participant's ability to evaluate a film for correct patient positioning. The participants' performance concerning their ability to evaluate patent positioning is illustrated in the box and whisker plot (Figure 4.5) below. Rating of patient positioning for image one (1) was predominantly high. The opposite was true for image five (5). Images three to five (2-4) had a varied analysis. A Kruskal-Wallis test showed a significant difference in the rating across the different image (p Value<0.0001).

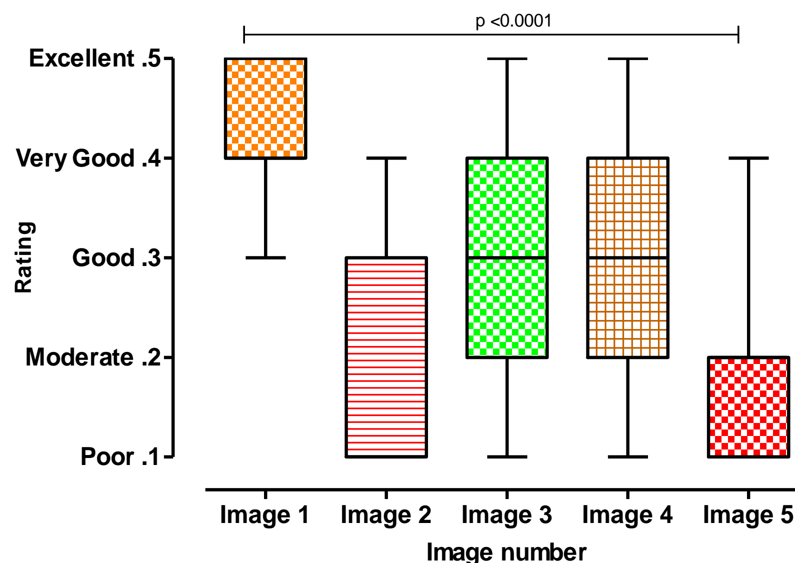

Figure 4.5: Patient positioning

The median score was 13 (IQR 11-18) for the cohort. A Wilcoxon signed-rank test was performed to compare the aggregate performance. There was a significant difference

between the actual score and the required score (p-value 0.0001). When competence was analysed 26 (84%) were assessed as not competent on their ability to evaluate positioning as shown in Figure 4.6.

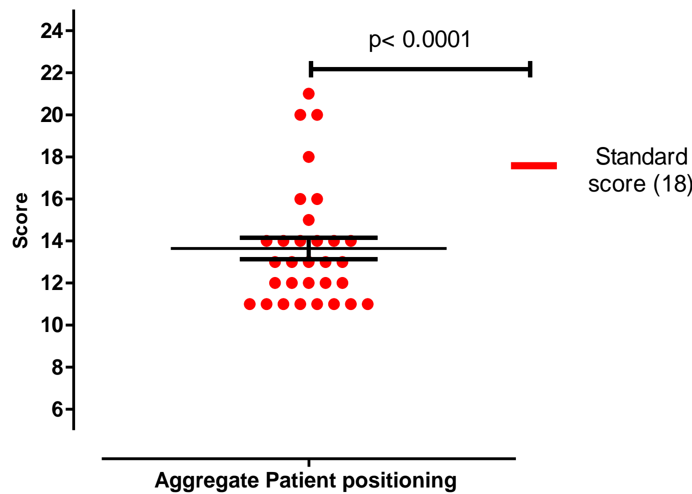

Figure 4.6: Patient positioning

A cross-tabulation between self-assessed competencies in patient positioning evaluation against actual competence score was also performed and the summary is shown in Table 4.6. It was noted that only one from those that rated themselves at level 3 competence and four from those that rated themselves at level 5 was competent following the assessment. When Fisher's exact test was performed, there was no significant difference among the individuals (p-value 0.231). Hence no association could be ascertained between self-evaluated competence in patient positioning and actual performance in the WBA.

Table 4.6: Self-assessment Vs actual competence in patient positioning

Self-assessed competence	Patient positioning competence		Total	**p-Value (Fisher's exact test)**
	Not competent	**Competent**		
2	2 (100%)	0 (0%)	2 (100%)	p = 0.231
3	4 (80%)	1 (20%)	5 (100%)	
4	10 (100%)	0 (0%)	10 (100%)	
5	10 (71%)	4 (29%)	14 (100%)	
Total	**26**	**5**		

4.2.3.3 Performance on the evaluation of correct exposure

The third category for assessment was the participant's ability to evaluate a film for correct exposure. The participants' performance with regard to their ability to evaluate correct exposure is shown in Figure 4.7 below. Rating of patient positioning for image one (1) was predominantly high. Other images had a variety of rating from the participants. A Kruskal-Wallis test showed a significant difference in the rating across the different image (p Value<0.0001).

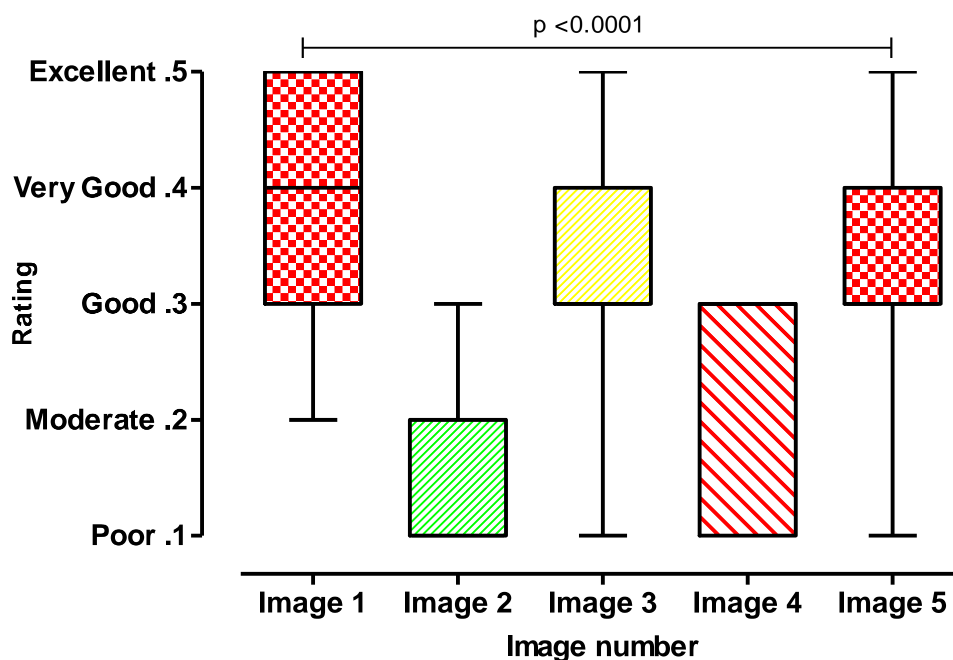

Figure 4.7: Rating of exposure evaluation

The mean score was 13.77 (SD 3.5) for the cohort. A Wilcoxon matched-pairs signed-rank test was performed to compare the aggregate performance as illustrated in Figure 4.8. There was a significant difference between the actual score and the required score (p-value <0.0001). When competence was analysed, almost all (97%) participants were assessed as not competent on their ability to evaluate film exposure.

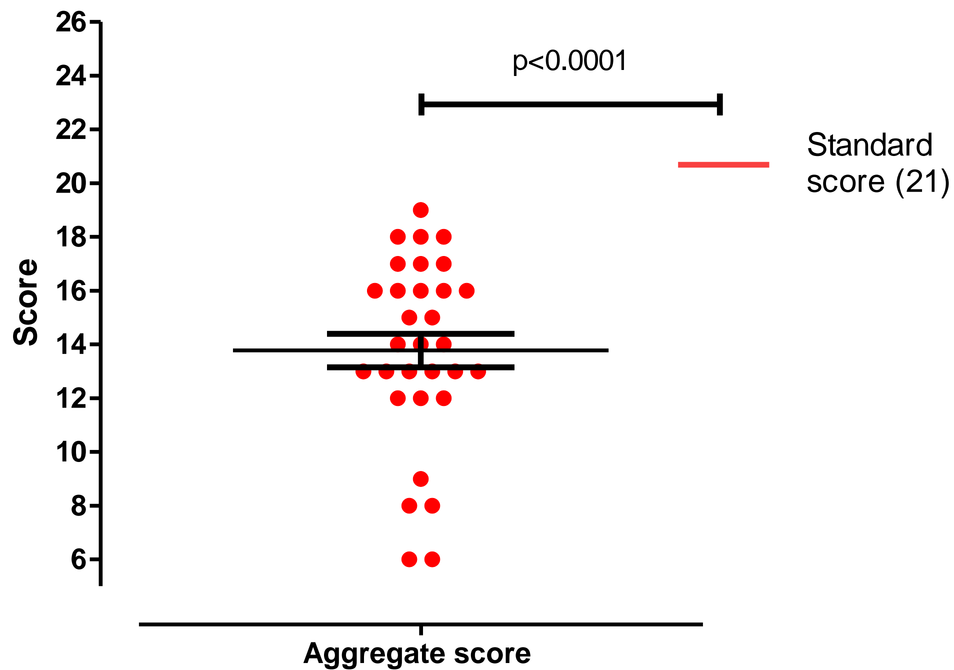

Figure 4.8: Aggregated exposure score Vs standard score

A cross-tabulation between self-assessed competencies in exposure evaluation against actual competence score was also performed. It was noted that only one (1) from those that rated themselves at level 5 competence was competent following the assessment. When Fisher's exact test was performed, there was no significant difference among the individuals (p=0.452). Hence no association could be ascertained between self-evaluated competence in evaluation of correct exposure and actual performance in the WBA (see Table 4.7).

Table 4.7: Self-assessment Vs actual competence in exposure evaluation

Self-assessed competence	Film exposure evaluation competence		Total	**p-Value (Fisher's exact test)**
	Not competent	**Competent**		
2	2 (100%)	0	2 (100%)	p=0.452
3	4 (100%)	0	4 (100%)	
4	17 (100%)	0	17 (100%)	
5	7 (87%)	1(13%)	8 (100%)	
Total	30	1		

4.2.3.4 Performance on the evaluation of film contrast

The ability of the participants to evaluate film contrast was also tested in the WBA. The participants' performance with regard to their ability to evaluate correct film contrast is depicted in the Figure 4.9 below. Rating of patient positioning for image two (1) was low. Other images had a variety of rating from the participants. The rating selection across the images was significantly different. This difference was tested using a Kruskal-Wallis test which showed a significant difference in the rating across the different image (p Value<0.0001).

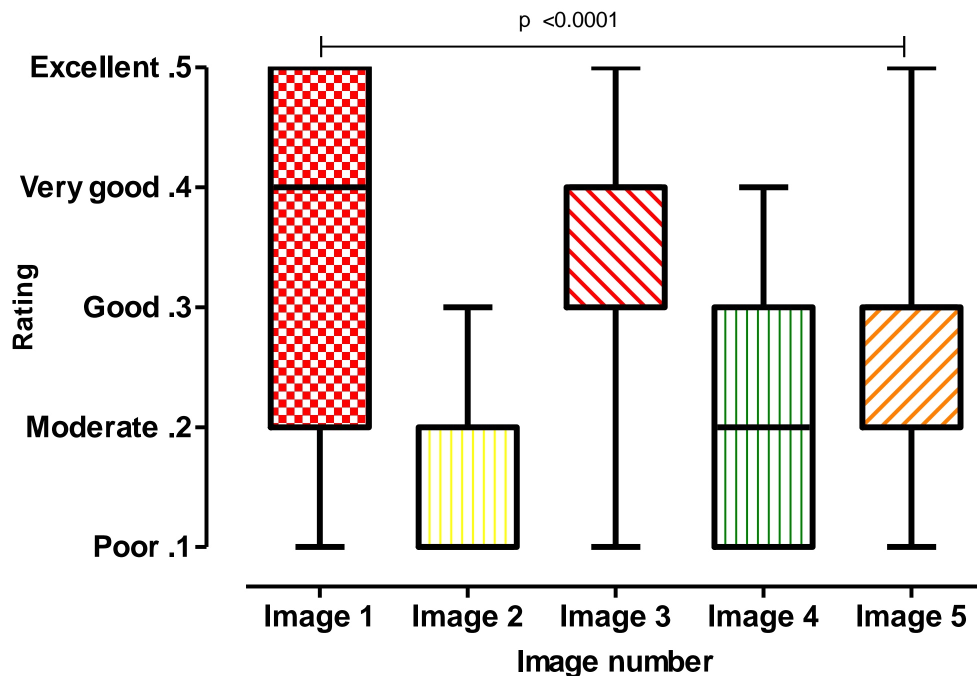

Figure 4.9: Rating of contrast evaluation

The mean score was 13.6 (SD 3.4) for the cohort. A Wilcoxon matched-pairs signed-rank test was performed to compare the aggregate performance. There was a significant difference between the actual score and the required score (p-value <0.0001). When competence was analysed (+/-2 of the cumulative standard score), High percentage of 77% (24) participants were assessed as not competent (see Figure 4.10).

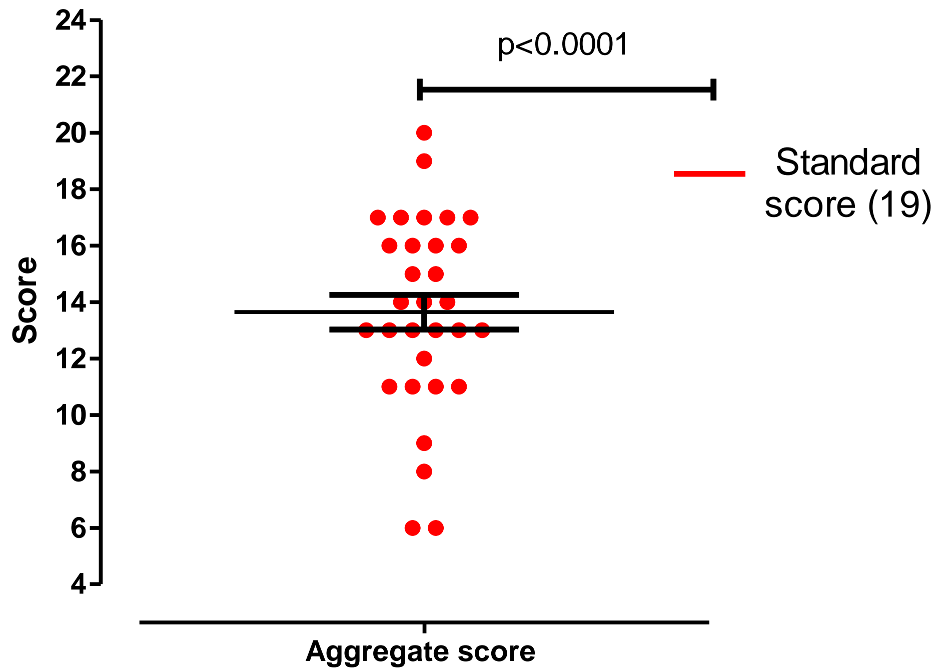

Figure 4.10: Aggregated contrast score Vs standard score

A review of a cross-tabulation between self-assessed competencies in contrast evaluation against actual competence score showed that of the seven (7) competent in this category four (4) had rated their ability to evaluate film contrast at level 5. When Fisher's exact test was performed, there was a significant difference among the individuals (p=0.002). Hence an association was apparent between self-evaluated competence in evaluation of correct contrast and actual performance in the WBA as shown by the p value in Table 4.8.

Table 4.8: Self-assessment Vs actual competence in contrast evaluation

Self-assessed competence	Film contrast evaluation competence		Total	**p-Value (Fisher's exact test)**
	Not competent	**Competent**		
2	3 (75%)	1(25%)	4 (100%)	p=0.002
3	14 (93%)	1 (7%)	15 (100%)	
4	7 (87%)	1(13%)	8 (100%)	
5	0 (0%)	4 (100%)	4 (100%)	
Total	**24**	**7**		

4.2.3.5 Performance on sharpness competence

The next category for assessment was the participant's ability to evaluate a film for image sharpness. The participants' performance with regard to their ability to evaluate correct sharpness is shown in the figure below. Rating of patient positioning for image two (2) and five (5) was predominantly low. Other images had a variety of rating from the participants. This difference was tested using a Kruskal-Wallis test which showed a significant difference in the rating across the different image (p Value<0.0001 as shown in Figure 4.11).

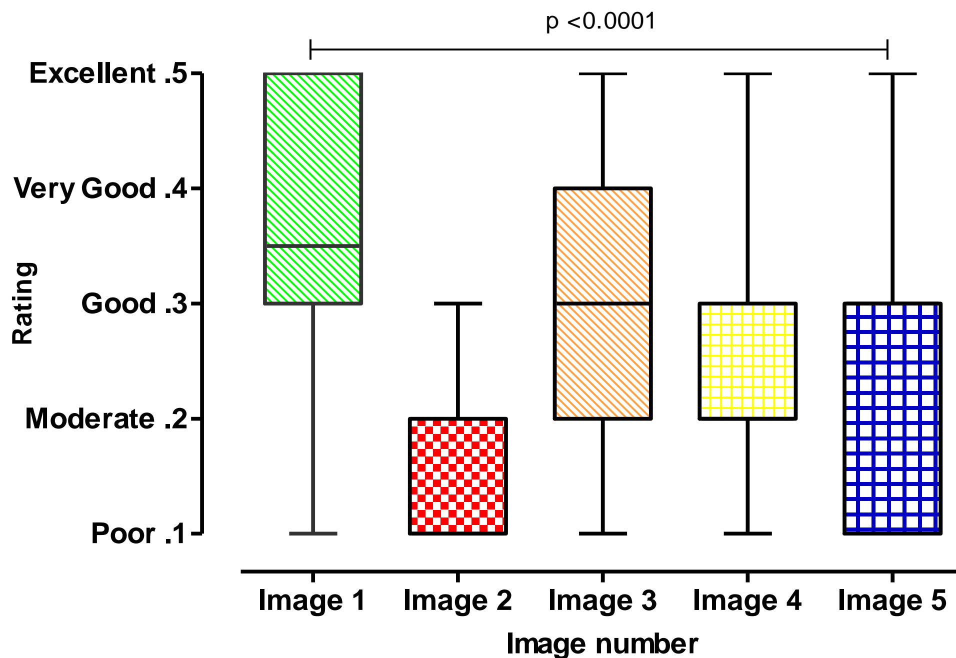

Figure 4-11: Rating of sharpness evaluation

The individual's aggregate performance in each of the five images was compared to the correct/standard score. The mean score was 13 (SD 3.33) for the cohort. A Wilcoxon matched-pairs signed-rank test was performed to compare the aggregate performance. There was a significant difference between the actual score and the required score (p-value <0.0001). When competence was analysed (+/-2 of the cumulative standard score), almost all (94%) participants were assessed as not competent as depicted in Figure 4.12.

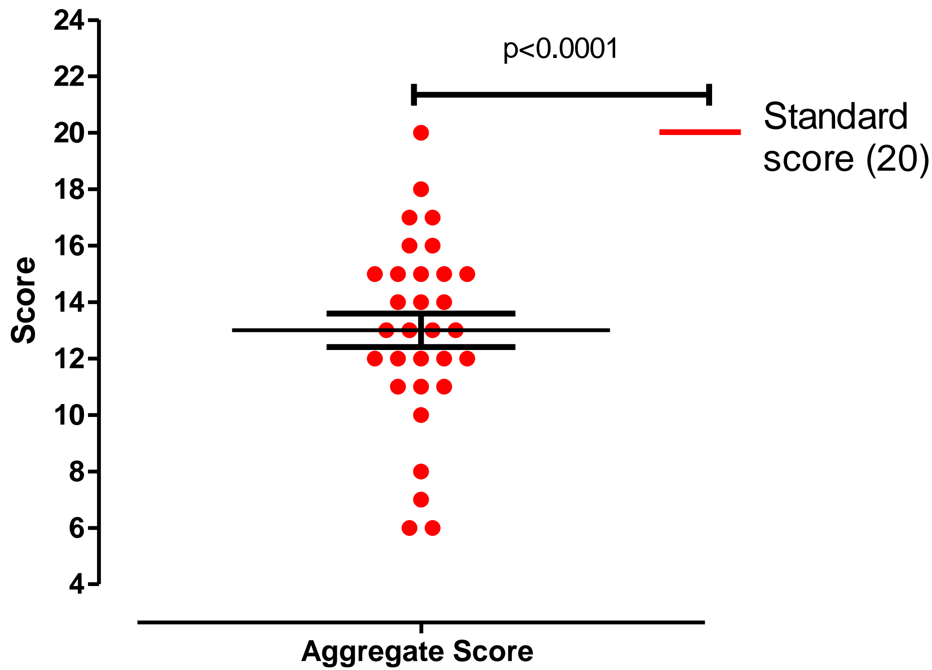

Figure 4.12: Aggregated sharpness score Vs standard score

A cross-tabulation between self-assessed competencies in image sharpness evaluation against actual competence score was also performed. It was noted that the two (2) competent had previously rated themselves as very good or excellent. When Fisher's exact test was performed, there was no significant difference among the individuals (p-value 0.058). Hence no association could be ascertained between self-evaluated competence in evaluation image sharpness and actual performance in the WBA as evidenced by the p value in Table 4.9.

Table 4.9: Self-assessment Vs actual competence in image sharpness evaluation

Self-assessed competence	Film shape evaluation competence **Not competent**	**Competent**	Total	**p-Value (Fisher's exact test)**
2	4 (100%)	0 (0%)	4 (100%)	P=0.058
3	19 (100%)	0 (0%)	19 (100%)	
4	5 (83%)	1 (17%)	6 (100%)	
5	1 (50%)	1 (50%)	2 (100%)	
Total	**29**	**2**		

4.2.3.6 Performance on annotation competence

In addition to the preceding categories, another assessment competency area was radiographer's ability to evaluate a film for correct annotation. The participants' performance with regard to their ability to evaluate correct image annotation is illustrated in the figure below. Generally, most of the participants rated the image annotation as low or moderate. However, when a Kruskal-Wallis test was done, there was a significant difference in the rating across the different image (p Value<0.0001 as shown in Figure 4.13).

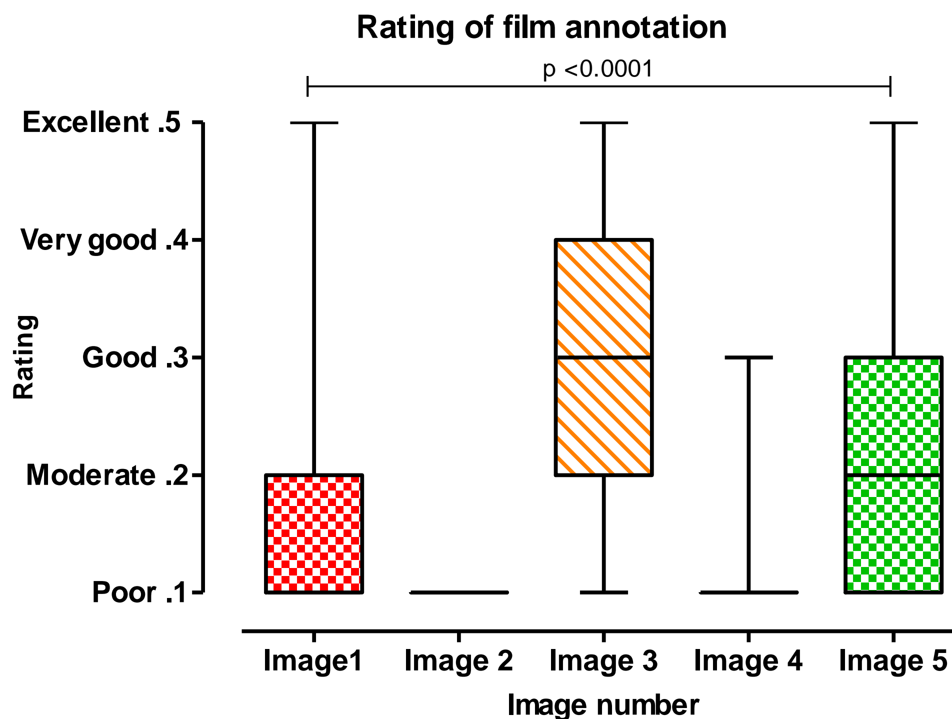

Figure 4.13: Rating of image annotation

The individual's aggregate performance in each of the five images was compared to the correct/standard score (see Figure 4.14). The mean score was 9.42 (SD 2.53) for the cohort. A Wilcoxon matched-pairs signed-rank test was performed to compare the aggregate performance. There was a significant difference between the actual score and the required score (p-value <0.0001). When competence was analysed (+/-2 of the

cumulative standard score), there was an almost equal distribution between the competent and non-competent.

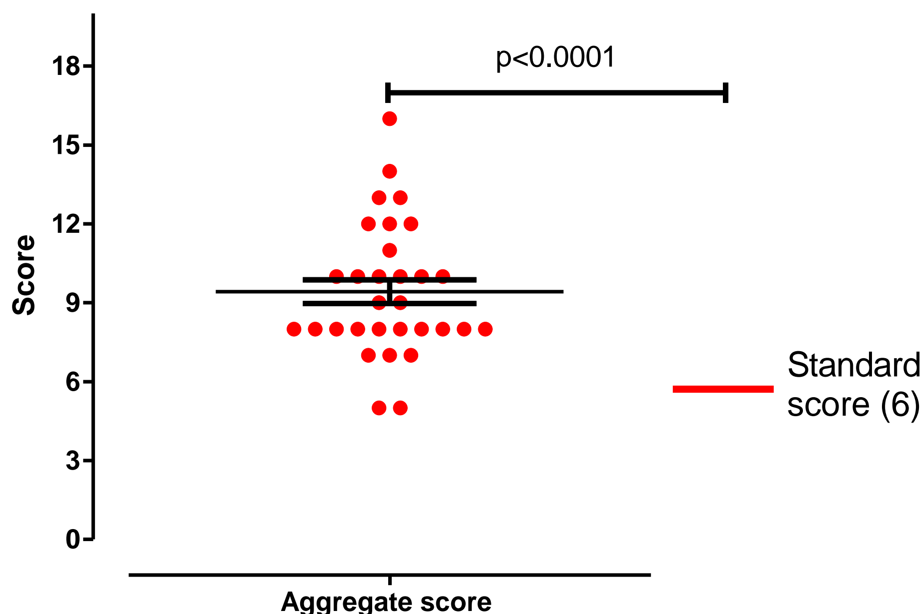

Figure 4.14: Aggregated image annotation score Vs standard score

A cross-tabulation between self-assessed competencies in image sharpness evaluation against actual competence score was also performed (Table 4.10). The highest competence rate of 62% (5) was amongst the individuals that had rated themselves as very good (4). When Fisher's exact test was performed, there was no significant difference among the individuals (p-value 0.634). Hence no association could be ascertained between self-evaluated competence in evaluation image sharpness and actual performance in the WBA.

Table 4-10: Self-assessment Vs actual competence in image annotation evaluation

Self-assessed competence in the annotation	Annotation competence		Total	**p-Value (Fisher's exact test)**
	Not competent	**Competent**		
2	0	1 (100%)	1 (100%)	P=0.634
3	4 (57%)	3 (43%)	7 (100%)	
4	3 (38%)	5 (62%)	8 (100%)	
5	9 (60%)	6 (40%)	15 (100%)	
Total	**16**	**15**		

4.2.3.7 Performance on radiation protection competence

The last category to be assessed was the radiographer's ability to assess the adequacy of radiation protection measures. The participants' performance with regard to their ability to evaluate correct image annotation is illustrated in the Figure 4.15 below. When a Kruskal-Wallis test was done, there was a significant difference in the rating across the different image (p Value<0.0001).

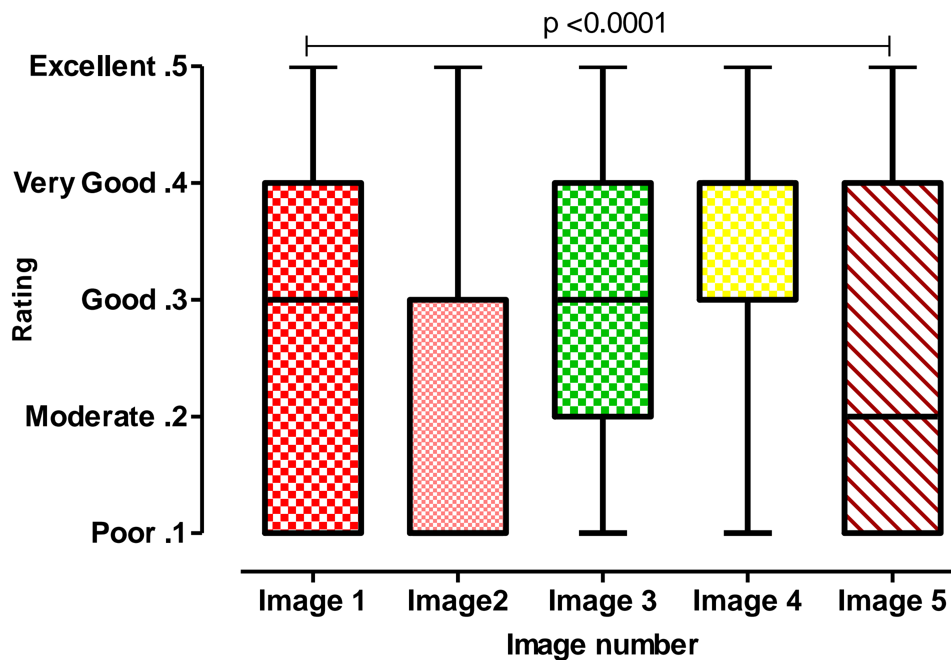

Figure 4.15: Rating of radiation protection adequacy

The individual's aggregate performance in each of the five images was compared to the correct/standard score. The mean score was 14.1 (SD 2.72) for the cohort. A Wilcoxon matched-pairs signed-rank test was performed to compare the aggregate performance. There was no significant difference between the actual score and the required score (p=0.0979). When competence was analysed (+/-2 of the cumulative standard score), there were more participants assessed as competent compared to the non-competent (61% to 39% respectively as shown Figure 4.16).

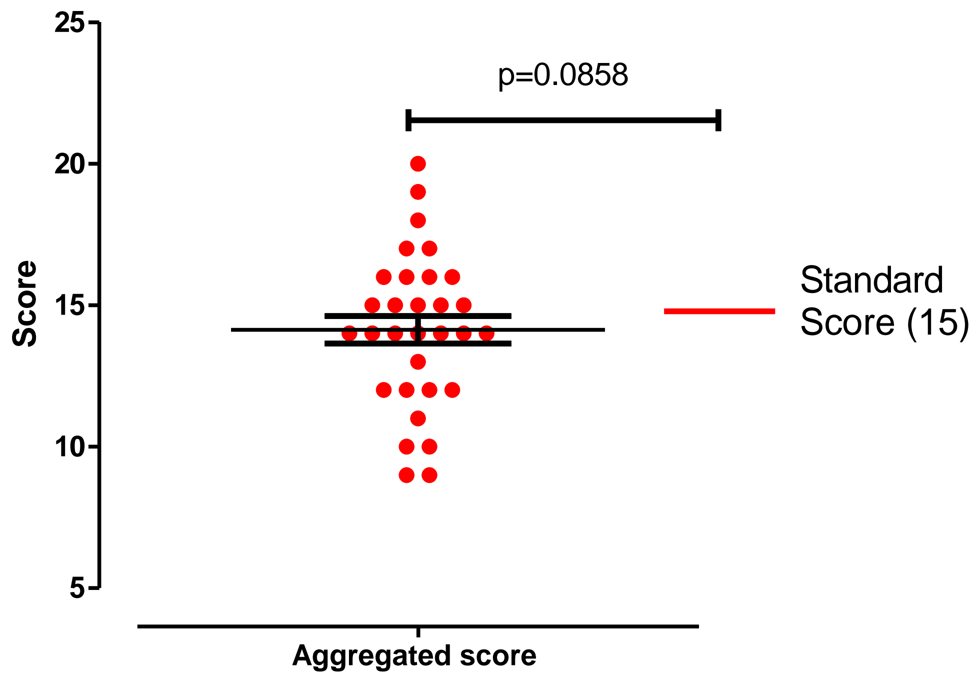

Figure 4.16: Aggregated radiation protection score Vs standard score

A cross-tabulation between self-assessed competencies in image radiation protection evaluation against actual competence score was also performed. The highest competence rate of 91% (10) was amongst the individuals that had rated themselves as very good (4). When Fisher's exact test was performed, there was a significant difference among the individuals (p =0.007). Hence an association could be ascertained between self-evaluated competence in evaluation image sharpness and actual performance in the WBA (Table 4.11).

Table 4.11: Self-assessment Vs actual competence in radiation protection

Self-assessed competence	Film shape evaluation competence		Total	**p-Value (Fisher's exact test)**
	Not competent	**Competent**		
3	1 (20%)	4 (80%)	5 (100%)	p =0.007
4	1 (9%)	10 (91%)	11 (100%)	
5	10 (67%)	5 (33%)	15 (100%)	
Total	**12**	**19**		

4.2.3.8 Overall performance

The Figure 4.17 below provides an aggregated performance of the participants across all the categories. There was a significant difference in performance (p<0.0001).

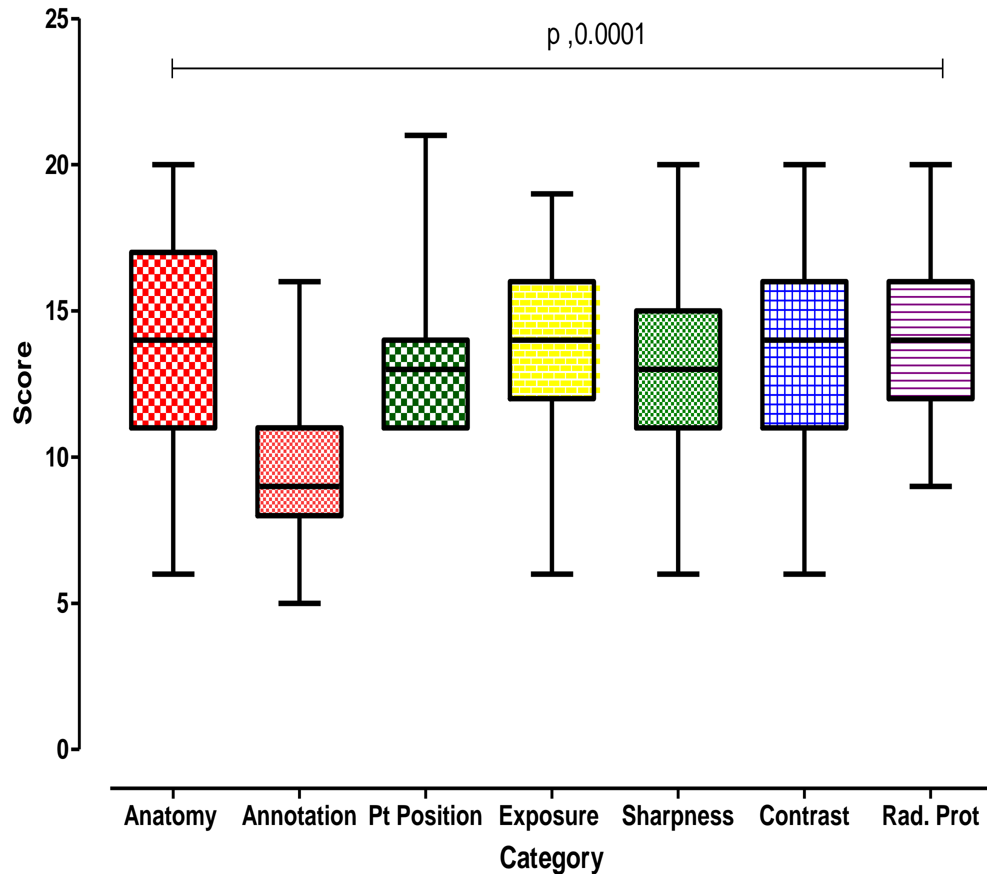

Figure 4.17: Overall performance across the different categories

An evaluation of the overall performance showed that only eight (8), representing 26% of the participants were assessed as competent. Using Fisher's exact test cross-tabulation was done between the various variables to determine if the outcome variable could be associated with the individual variables (Table 4.12). Furthermore, a correlational analysis was performed to show the relationship that existed among the variables. The Table 4.13 illustrates the correlational matrix.

Table 4.12: Cross-tabulation of variables with overall competence

Institution	Overall competence		p-Value
	Not competent	Competent	
Arthur Davison children's Hospital	5 (100%)	0 (0 %)	0.149
Ndola Teaching Hospital	1 (33%)	2 (67 %)	
Kitwe Teaching Hospital	4 (57%)	3 (43%)	
University Teaching Hospital	9 (75%)	3 (25%)	
Chipata Teaching Hospital	4 (100%)	0 (0%)	
Sex			
Male	8 (57 %)	6 (43%)	0.097
Female	15 (88%)	2(12 %)	
Years post-qualification			
3	5 (50%)	5 (50%)	0.181
4	7 (100%)	0 (0 %)	
5	2 (100%)	0 (0 %)	
6	7 (67 %)	2 (33%)	
7	2 (74%)	1 (26%)	
Years of experience in plain film imaging			
1	21 (72 %)	8 (28%)	1.000
2	2 (100%)	0 (0%)	
Number of Chest x-rays performed per week			
Less than 5	1 (100%)	0(0%)	0.343
Between 10 and 15	5 (100%)	0(0%)	
Between 15 and 20	3 (100%)	0(0%)	
Over 20	14 (74%(	8 (25%)	

Table 4.13: Correlation matrix

	Age	Years of Practice	Freq. of CXR	Self-assess. score	Anatomy score	Annotation score	Positioning score	Exposure score	Sharpness score	Contrast score	Rad prot, score
Age	1.0000										
Years of Practice	**0.9781***	1.0000									
	0.000										
Freq of CXR	0.1529	0.1942	1.0000								
	0.4116	0.2953									
Self assessment score	0.2173	0.2871	**0.4346***	1.0000							
	0.2403	0.1173	0.0146								
Anatomy score	0.1955	0.1556	**0.4752***	**0.3690***	1.0000						
	0.2919	0.4033	0.0069	0.0411							
Annotation score	0.0408	0.082	-0.0646	**0.3693***	0.1942	1.0000					
	0.8274	0.661	0.7299	0.0409	0.2951						
Positioning score	0.078	0.0548	0.1421	0.2785	**0.5553***	0.1384	1.0000				
	0.6767	0.7698	0.4458	0.1293	0.0012	0.4579					
Exposure score	0.0606	0.0876	**0.5504***	**0.6063***	**0.6329***	0.2764	**0.4767***	1.0000			
	0.7461	0.6394	0.0013	0.0003	0.0001	0.1322	0.0067				
Sharpness score	0.2834	0.3103	**0.4836***	**0.6645***	**0.6987***	0.1903	**0.4898***	**0.8665***	1.0000		
	0.1224	0.0894	0.0059	0.0000	0.0000	0.3051	0.0052	0.0000			
Contrast score	0.1414	0.145	**0.5744***	**0.6460***	**0.7280***	0.1634	**0.5117***	**0.8978***	**0.8708***	1.0000	
	0.4479	0.4365	0.0007	0.0001	0.0000	0.3798	0.0033	0.0000	0.0000		
Rad prot score	0.1543	0.1055	0.1252	-0.1465	**0.3909***	0.0886	**0.3868***	0.326	0.301	0.2926	1.0000
	0.4072	0.5723	0.5023	0.4317	0.0297	0.6357	0.0316	0.0735	0.0998	0.1102	

In order to evaluate the influence of the variables on the main outcome variable, which was competence signified by the term pass, a multilevel logistic regression was modelled to show the relationship. The Table 4.14 below summarises the model.

Table 4.14: Table showing the regression model

Pass	OR	P>]z]	95% confidence interval	
Sex	8.38×10^{-9}	<0.0001	9.63×10^{-12}	7.29×10^{-6}
Age	0.1300294	0.071	0.0142	1.187071
Self-rated competency	1.777675	<0.0001	1.333	2.369

The variables with an effect on the competency classification of the participants were sex and rating of self-perception. The odds were 1.8 times (Confidence interval 1.3-2.4) higher amongst those with a higher self-rated level of competency than those with a lower self-rated competency. With regard to the sex of participants, females were less likely to be competent compared to their male counterparts (p<0.0001). A unit increase in age was associated with lower odds of 0.13(CI 0.01-1.19). However, age was found not to be a significant predictor of competency. Other variables like years of practice, frequency of performing a chest x-ray, and scores on individual items were initially included in the model although they did not result in a notable effect.

4.3 Development of job Competency list

This phase of the study was meant to address the first objective of the study, which was to establish the contemporary job competencies for diploma radiographers. This stage utilised a qualitative survey using a Delphi technique to arrive at a consensus on the contemporary roles of a Zambian radiographer.

4.3.1 Participant attributes

They were more males than females. The males accounted for 72% (n=31) of the total participants of the study. Another demographic characteristic considered was the years of

experience. The participants were categorised in three brackets (10 to 14, 15 to 19, and over 20). The bracket from 10 to 14 was the largest accounting for 44% (n=19).

The employment sectors in which the participants are employed were also characterised. The majority of the participants, 79% (n=34) were working in government health facilities. Further analysis of the employment status shows that participants were drawn from educators, administrators and clinical practising radiographers. The employment rank amongst clinical practising radiographers ranged from chief radiographer to radiographer. Also included in the study were representatives from the Radiological Society of Zambia (RSZ). An analysis of the provincial distribution of the respondents showed that all provinces were represented with Lusaka accounted for the majority n=18 (42 %,) of the respondents. This is summarised in Tables 4.15 a and b.

Table 4.15 a: Phase one participants' attributes

<table>
<tr><th colspan="2">Characteristic</th><th>Number</th></tr>
<tr><td rowspan="2">Sex</td><td>Female</td><td>12 (28%)</td></tr>
<tr><td>Male</td><td>31 (72%)</td></tr>
<tr><td rowspan="3">Years of experience</td><td>10 to 14</td><td>19 (44%)</td></tr>
<tr><td>15 to 19</td><td>14 (33%)</td></tr>
<tr><td>20 and above</td><td>10 (23%)</td></tr>
<tr><td rowspan="4">Organisation</td><td>Ministry of Health</td><td>34 (79%)</td></tr>
<tr><td>Ministry of Defence</td><td>2 (5%)</td></tr>
<tr><td>Ministry of Education</td><td>4 (9%)</td></tr>
<tr><td>Private facilities</td><td>3 (7%)</td></tr>
<tr><td rowspan="8">Position in organisation</td><td>Educators</td><td>6 (14%)</td></tr>
<tr><td>MoH Admin/national coordinator</td><td>1 (2%)</td></tr>
<tr><td>Provincial coordinator</td><td>7 (16%)</td></tr>
<tr><td>Chief radiographer</td><td>2 (5%)</td></tr>
<tr><td>Principal radiographer</td><td>4 (9%)</td></tr>
<tr><td>Senior radiographer</td><td>7(16%)</td></tr>
<tr><td>Radiographer</td><td>14 (33%)</td></tr>
<tr><td>RSZ representative</td><td>2 (5%)</td></tr>
</table>

Table 4.15b: Phase one participants' attributes

Characteristic		Number
Provincial distribution	Lusaka	18 (42%)
	Copperbelt	4 (9%)
	North Western	3 (7%)
	Western	3 (7%)
	Southern	3 (7%)
	Eastern	3 7%)
	Central	3(7%)
	Luapula	2 (5%)
	Muchinga	2 (5%)
	Northern	2 (5%)

4.3.2 Round 1 Delphi

The first questionnaire was modelled on work conducted by Williams and Berry (1999). The goal was to obtain consensus on the definition of a radiographer, contemporary competencies and future roles.

4.3.2.1 Description of radiographer

The majority 53.4 % (n=23) of the respondents in the first circulation strongly agreed with the description. Despite the majority indicating a strong level of agreement, participants suggested amendments to the description as evidenced by the following;

"With the changing trends in the health profession and coupled with the never satisfied staffing levels of the much needed skilled workforce of the radiologists, this statement stood high and tall some thirty or twenty years ago. In recent past, radiographers have taken up some of these roles of radiologists, visa viz to give preliminary reports and actually doing some if not most of the investigations done by the aforesaid professionals." (***Respondent No 4 Delphi 1***)

'The above sentence about the primary role of radiographers is a traditional role of radiographers. With education i.e. higher levels, such as MSc, PhD, this is no longer a

single primary role of Radiographers. There is role extension now in the field of Radiography due to higher levels of education and training' **(Respondent No3Delphi 1)**

4.3.2.2 Classification of radiographer job roles

In addition to the list provided, participants proposed more items, as shown in the table below. The Table 4.16 also shows the number of sources and references that referred to the additional categories (Sources refer to the number of interviews or meetings in which the particular theme was mentioned. Reference are the number of incidences the was mentioned).

Table 4.16: Additional categories

Name	Sources	References
Education and training	5	8
Research	5	5
Film reporting and extended roles	2	2
Community outreach	1	1
Consultancy	1	1
Ethical	1	1

The remarks from the participants which emphasise the suggested categories include:

"Assessment of students during training, attending update meetings with training institutions to get updates on curriculum needs for student radiographers" **(respondents No 24 Delphi 1)**

"Educational/ Teaching of radiography technologists as well as radiography students and electives should not be overlooked." **(Respondent No 4 Delphi 1)**

"Radiography research - effective skills in data collection and analysis provide a preliminary report for images in chest x-ray and musculoskeletal imaging,"

(Respondent No 24 Delphi 1)

4.3.3 Round 2

4.3.3.1 Description of radiographer

In the second round of data collection, the original description was extended as ''The primary role of radiographers is to assess patients and their clinical requirements in order to apply the appropriate radiographic techniques; pursuant to producing Images of diagnostic value, furthermore, to undertake additional roles that enhance radiography service delivery subject to appropriate training'' The result of this enquiry process demonstrates that the majority 79% (n=34) of the participants strongly agreed with the revised description (see Figure 4.18)

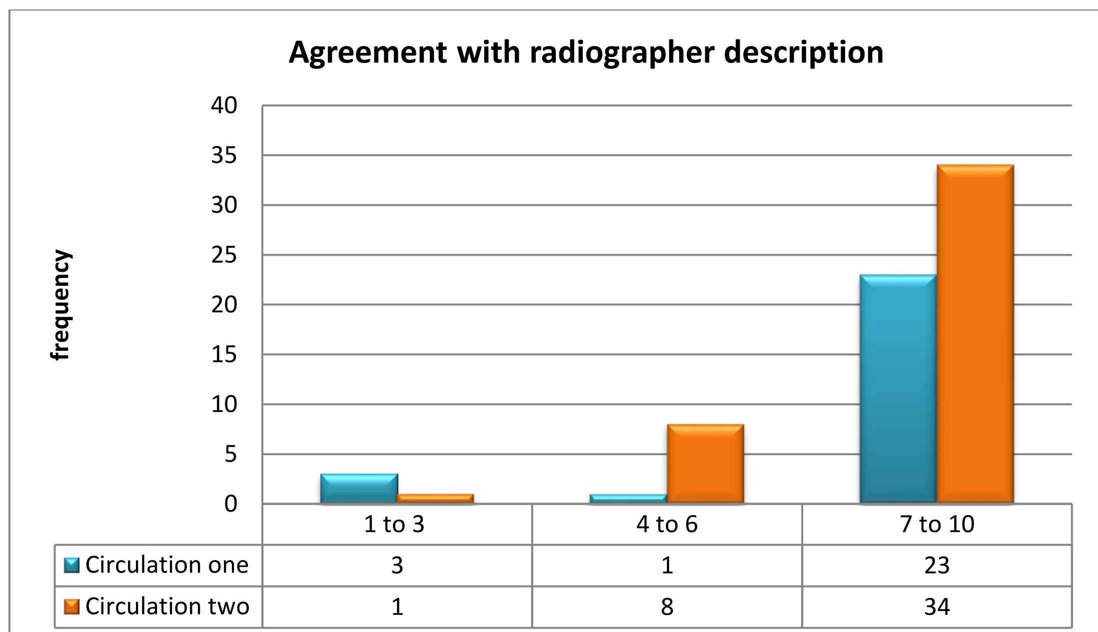

Figure 4.18: Level of agreement with the description

. In supporting this level of the agreement, the following were the comments from the participants;

"The Refined description provides a more detailed and specific outline of the primary role of a Radiographer" ***(Respondent No 1 Delphi 2)***

4.3.3.2 Competency categories

Following both rounds of the Delphi survey, the refined the list generated is illustrated below. It must be noted that some of the suggested categories had already existed as components of the initial list provided (Table 4.17).

Table 4.17: Finalised competency categories

Categories from literature	Participants suggested categories
Professional	Professional
Clinical	Clinical
Interpersonal	Interpersonal
Patient care	Patient care
Technical	Technical
Administrative	Administrative/Management
Theoretical	Training/Education
	Research

In terms of agreement with the refined categories, the figure below illustrates the level of agreement. There was a strong agreement with the new categorization. Participants who selected this ranking constituted over 95% (n=42) of the study participants.

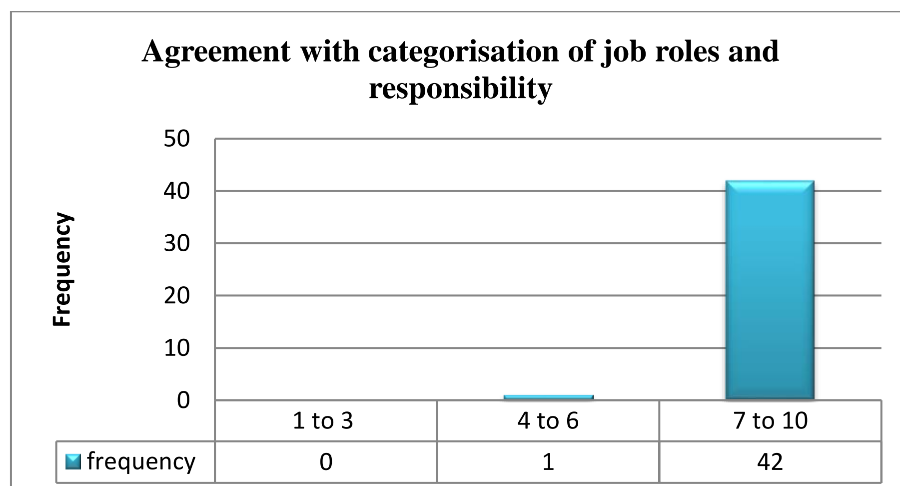

Figure 4.19: Level of agreement with categorisation

When the participants were asked to provide reasons for this level of agreement, the following were the sentiments provided;

"Medical Imaging is an ever-evolving and dynamic discipline owing to a great extent to research for Technological advancement and enhancement of Technical Productivity. It is thus imperative that Training/Education and Research stand as core components of the primary role of a Radiographer" ***(Respondent No 1 Delphi 2)***

"Being an independent professional discipline Radiographer should be able to undertake the above-stated role and Responsibilities, in order for them to govern themselves well. Radiographers should not wait for someone from another professional to come and govern them. It should be a standard alone discipline respected and recognised like others." (***Respondent No 2 Delphi 2)***

4.3.3.3 Radiographer competencies

Participants were requested to suggest roles and responsibilities in each of the nine categories.

4.3.3.4 Professional Competencies

The final list of roles and responsibilities under the professional category from the initial Delphi selection is illustrated In Tables 4.18 a and b below.

Table 4.18 a: Professional competencies

Name	Sources	References
Promotion of the radiography profession	5	5
Adherence to quality standards	5	5
Technical competence	4	6
CPD & Career development	4	5
A multidisciplinary approach to care	4	4
Observe the code of ethics	3	3

Table 4.19 b: Professional competencies

Name	Sources	References
Observe the code of conduct	3	5
Affiliation to a professional body	2	2
Adhere to radiation protection practices	2	2
Appropriately qualified	1	1
Adherence to QA and Quality improvement	1	1
Compliance with regulation	1	1
Conduct research and development of proposals	1	1

The responsibilities and roles considered to be misplaced following the second Delphi iteration included; Adherence to QA and Quality improvement, Conduct research and development of proposals, and multidisciplinary approach to care.

The participants' reasons for the suggested misplaced roles are echoed by the following sentiments;

*Adherence to QA& QI is misplaced under this category, I suggest it goes to category clinical. Same applies to a multidisciplinary approach to care (**Respondent no27 Delphi 2**)*

4.3.3.5 Clinical Competencies

In terms of ascertaining the clinical roles and responsibilities participants were asked to list the roles and responsibilities that are included in this category. The Table 4.19 below summarises the participant's thoughts. The top two items were; performing radiographic examinations in order to produce images of diagnostic value, and practice according to standard operating procedures.

Table 4.20: Clinical Competencies

Name	Sources	References
Perform radiographic examinations in order to produce images of diagnostic value	9	9
Practice according to standard operating procedures	9	9
Undertake film reporting	7	7
Ensure adherence to radiation protection measures	5	5
Provide appropriate patient care	4	4
Operate equipment in a safe and efficient manner	3	3
Work multidisciplinary manner to ensure best practice	3	3
Assess and evaluate the patient before undertaking procedures	2	2
Practice high level of infection prevention	1	1
Provide Innovation to the radiographic diagnostic process	1	1

When the participants were asked to list roles or categories that they considered as misplaced or needed further consideration, film reporting was noted. Some indicated that this role was not the domain of radiographers. Some of the sentiments expressed on this issue include;

"Clinical- Undertake film reporting should be considered with caution. To what extent do we want this cadre to go" (**Respondent No 29 Delphi 2**)

"Undertake film reports (not scope of a radiographer)" (**Respondents No 6 Delphi 2**)

4.3.3.6 Interpersonal Competencies

Participants were asked to list the roles and responsibilities that could be aligned under the category of interpersonal roles and responsibilities. The Table 4.20 below summarises the responses. The items referred to the most included; Multidisciplinary approach, Team player, and Practice Emotional intelligence.

Table 4.21: Interpersonal competencies

Name	Sources	References
Multidisciplinary approach	9	9
Team player	9	11
Practice Emotional intelligence	6	6
Effective Communication with patients and staff	4	4
Respect others	2	2
Conflict management	1	1
Good listener	1	1
Learning mentality	1	1
Valuing cultural diversity	1	1

4.3.3.6 Patient Care Competencies

Another area which required participant input concerning roles and responsibilities was patient care. Under this category, the most noted aspect was that of patient comfort, safety and security as shown in Table 4.21.

Table 4.22: Patient care competencies

Name	Sources	References
Patient comfort, safety and security	9	9
Information provision & consent	6	6
Psychological care	5	5
Ensure a holistic care approach is taken	3	3
Radiation protection	3	3
Infection prevention	2	2
Patient privacy and confidentiality	2	2
Provide appropriate care according to need	2	3
Provision of efficient service	2	2
Patient assessment	1	1

4.3.3.7 Technical Competencies

To build a consensus on the job roles, participants were asked to itemise the roles and responsibilities that could be classified under the technical competencies. The Table 4.23 below summarises the responses into eight areas. Implementing image quality management and being part of the care and maintenance programme ranked highest in terms of the number of participant's proposals.

Table 4.23: Technical competencies

Name	Sources	References
Implement image quality management	7	7
Part of the care and maintenance programme	6	6
Implement equipment QA programme	5	5
Technical competence to understand and operate high technological equipment	5	5
Technical support (policy and procurement)	4	4
Ensure patient safety and security	2	2
Participate in clinical Audit activities	2	2
Technical support (mentorship)	2	2

4.3.3.8 Administration and Management Competencies

Participants were also asked to list competencies that could be categorised under administration and management. Departmental organisation and coordination, and Stock and inventory management ranked highest among the most proposed competencies. The summary is depicted in Table 4.24

Table 4.24: Administrative and management competencies

Name	Sources	References
Departmental organization and coordination	10	11
Stock and inventory management	10	10
human resource management (capacity building, planning, appraisal)	5	6
Budget and planning	4	5
Leadership and directing of radiography services	4	4
Programming, scheduling and workflow management	4	5
Resource mobilization and management	4	5
Data and record management	3	4
Equipment management and planning	2	2
QA programme implementation	1	1

4.3.3.9 Future roles and responsibilities

One of the main components of this phase of the study was to establish the future roles and responsibilities that would be added to the current practice of radiographers in Zambia. The Table 4.25 depicts the summarised responses from the participants concerning this aspect. The wish to include film reporting as a standard feature of the radiographer roles was very prominent amongst the participants.

Table 4.25: Future roles and responsibilities

Name	Sources	References
Film reporting	15	17
Role extension	7	7
Training	4	4
Disease survey and monitoring	2	3
independent research	2	2
PACS and RIS management	2	4
management of contrast side effects	1	1
Performance of special studies independent of medical	1	1
Phlebotomy	1	1
Equipment maintenance	1	1
Forensic radiography practice	1	1
Veterinary radiography	1	1

The reasons for suggesting the above list is represented by the following verbatim;

"Need for radiographers to be formally involved in the formulation of the provisional report for patients. The change will be for patient reports on time and the impact will be patients will be attended to on time by the referring clinicians" (***Respondent No 10 Delphi 2***)

4.4 Consensus on radiographer competences and global rating of performance

This part of the study sought to complete consensus building on the job roles for a radiographer. It also responded to the second objective which was to analyse the extent

to which post-registrations radiographers who graduated from the TEVETA radiographer training programme after 2010 meeting the job requirements of a radiographer for primary, secondary, and tertiary care in Zambia. This phase utilised FGDs to answer particular research questions.

Point of departure for the description of the findings is to present the attributes of participants of this phase of the study. The study findings in terms of consensus building and views of experienced radiographers are then presented.

4.4.1 Attributes of FGD participants

The characteristics which will be relevant for the discussion regarding this phase of the study included; sex distribution, workplace distribution, years of experience, and educational background. The male participants were more than the female counterparts in both groups. With regards to the work placement, the majority of participants were drawn from those employed in government hospitals. Other participants were drawn from academic, private hospitals and Ministry of Health administrative positions.

It was also important to characterize the participants in terms of years of experience. The majority of the participants 58% (n=10) fell into the bracket of 10 to 15 years of work experience. In terms of their qualifications, this ranged from diploma to a master's degree. Close to half 47% (n=8) had a first degree as the highest qualification whilst 5 had a master's degree. The participants characteristics are summarised in Table 4.26.

Table 4.26: FGD participants attributed

Attribute		Focus Group Discussion	
		FGD 1	FGD2
Female: Male ratio	Female	2	3
	Male	8	4
		10	7
Institution	Academic institutions'	2	
	Government Hospitals	5	6
	Private Hospitals	1	
	Ministry of Health	2	1
		10	7
Years of experience	10 to 15	5	5
	15 to 20	3	2
	20 and above	2	0
		10	7
Level of qualification	Masters	5	1
	Degree	5	2
	Diploma		4
		10	7

4.4.2 Findings from FGD

The views of the participants on the various discussion points have been arranged alongside the thematic points that guided the focus group discussion. The thematic areas are shown in the Figure 4.20 below.

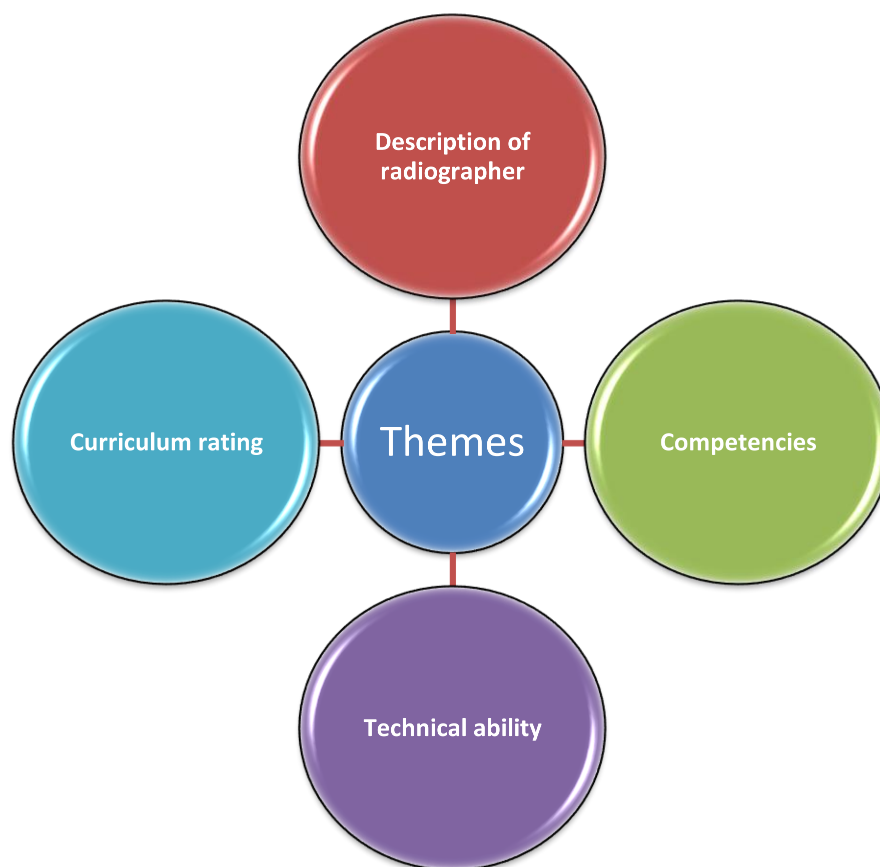

Figure 4.20: Thematic areas

In each of the thematic areas, main themes and sub-themes were identified following the analysis of the transcripts. Table 4.27 a and b below illustrates the coding and the coding percentage for each of the main themes studied using the FGDs.

Table 4.27 a: Themes and sub-themes for the FGD

Thematic area	Main themes	Subthemes	Sources	References	Percentage Coverage	
					FGD 1(%)	FGD 2 (%)
Description of radiographer	Agreement with description of radiographer	Agreement with description Patient assessment (Issues with radiographer assessing patient &Agreeing with radiographers assessing patient	2	2	4.26	11.06
Competencies	Professional	Agreement, Issues with performance of QA, Omitted roles in professional category	2	7	2.21	4.94

Table 4 27 b: Themes and sub-themes for the FGD

Thematic area	Main themes	Subthemes	Sources	References	Percentage Coverage	
					FGD 1(%)	FGD 2 (%)
Competencies	Clinical	Agreement with roles	2	14	4.66	7.77
		Film reporting (Controversy with reporting, Agreeing with film reporting, & Training as an important element prior to reporting				
	Interpersonal	Agreement with interpersonal role list	2	9	4.44	2.26
		Roles that were not clear (Cultural diversity, Emotional Intelligence, & Multidisciplinary)				
	Patient care	Agreement with patient care roles	2	4	1.72	1.36
		Roles that were not clear				
		Understanding of psychological care				
	Technical	Agreement with roles	2	6	2.41	1.83
		Roles not clear				
		understanding of the role in the maintenance				
	Administration	Agreement with listed administrative roles	2	10	4.83	3.74
		Changes to administrative roles				
		Unclear Roles				
		understanding of mobilisation roles				
		support to maintain it				
Technical ability	Rating of subordinate technical ability	High, moderate or low	2	13	13.15	4.32
	Rating of supervisors technical ability	High, moderate or low	2	10	6.45	7.31
Curriculum rating	Meets criteria		2	6	4.28	1.67
	Did not meet					

4.4.2.1 Thematic area 1: Description of radiographer

During the discussion, three themes emerged with regard to the description provided from the first phase of the study.

Sub theme1 Agreement with description

The initial step in the discussion was to ascertain the extent to which the group participants agreed with the description that was provided to them. In general, the

participants agreed with the refined description. This is illustrated by the view of one of the participant.

*"Strongly agree with the refined definition of the radiographer as we know that radiography has evolved with the number of years and we have a lot of imaging modalities for specific clinical situations. Unlike in the past where the clinical form comes from the doctor or a clinician who demanded an ultrasound or x-ray which as a radiographer who has studied different modalities is able to tell that this modality is correct for the particular clinical question." (**FGD 1**)*

Sub-theme 2 Issues with radiographer assessing patient

A conflict of the option was evident with respect to the part of the description that emphasized on radiographers assessing patients prior to instituting a radiological examination. Some of the participants were not comfortable with the inclusion of patient assessment as demonstrated below.

*"I am not clear on the part of the assessment, whether is the doctor's assessment or clinicians or patients, it is not clear and it's not clear on how radiographers should assess these patients". (**FGD 1**)*

*"I think there are a number of words we can use only that I feel this would result in a conflicting of duty because the assessment is the duty of a medical doctor. Sometimes a doctor would write that they need chest, abdominal and back so you have to do what they have asked for because when you mix with things from your own assessment it would result in a conflicting duty." (**FGD 2**)*

*"Where they are saying 'assess' I am not clear on the part of the assessment, because we can just work on the request of from the doctor's assessment or clinicians." (**FGD 2**)*

In contradiction to the views represented in the foregoing, other participant's took the view that patient assessment by radiographers is essential because proper imaging is based on having a sound basis for performing an imaging examination. Proponents of the notion that radiographer should assess patient indicated the following:

*"an example of an assessment, I think is what we had in the case we had today (the day of the interview) where the clinician wrote that the radiographer should do a chest x-ray when the patients had a shoulder dislocation. Therefore, as a radiographer, you are able to assess whether it is necessary to do the whole chest or just particular part with a dislocation so as to protect the patient the effects of the rays and not always just relying on the information from the doctor or clinician." **(FGD 2**)*

*"It is important to assess the patients before doing what the doctor has said and without relying much on what the doctor has said because doctors are overloaded and overwhelmed with a lot of patients and sometimes they can also make mistakes of which as a trained radiographer you can assess and avoid such mistakes and wastage of resources."**(FGD 2**)*

4.4.2.2 Theme 2: Radiographer competencies

The agreed competency categories included were; Professional, Clinical, Interpersonal, Patient care, Technical, Administration, and Theoretical.

Sub-theme 1: Professional competencies

The summarized list of competencies (Appendix 8) was presented for discussion to the two focus groups. During the discussion, three themes emerged as presented below.

Sub-sub theme 1: Agreement with categorization

Participants were asked to express their agreement or disagreement with the list of competencies which relate to professional competencies. When the first and second

focused groups were asked about the adequacy of the categorization, they responded in the affirmative. The following were some of the sentiments expressed.

*“The list encompasses most of the important aspects especially where it says conduct research and development protocols and Adhere to radiation protection practices which have been missing in our country on the protection of the radiographers. Thus the list is ok”. (**FGD 2**)*

*“Most of the important aspects such as conducting research and development protocols and adherence to radiation protection practices” (**FGD 1**)*

Sub-sub theme 2 Issues with the performance of QA

An area of concern with regard to professional competencies was the performance of quality assurance by radiographers. Despite agreeing with the inclusion of this aspect in the professional competences, participants noted that the work environment did not support its implementation. Some of their thoughts are presented below.

*“where the list says adherence to quality assurance and quality improvement, there is a problem in our country because don’t have quality x-ray machinery for example in our case the x-ray machinery we are using is an old standard one with some forts so when you want to do some task which requires some adjustments you can’t because the machine cant adjust to that extent.”(**FGD 2**)*

*“Our hospitals do not have quality x-ray machinery, hence there is a problem in adherence to quality assurance and quality improvement.” (**FGD 1**)*

Sub-sub theme 3: Omitted roles in the professional category

Participants noted that the issue of affiliation to the professional and regulatory bodies was omitted.

*"The other important aspect which has been overlooked in most of the cases is the affiliation to the profession board in this case HPCZ and the radiological society of Zambia." (**FGD 2**)*

Sub-theme 2: Clinical competencies

During the discussions, the list of clinical competencies generated from the first phase of the presented for debate. At the time of analysis, two main themes were identified. In the second main theme, three further sub-categories identified.

Sub-sub theme 1: Agreement with roles

When the participants were asked if they agreed with the listed competencies, most of them agreed in general with the list.

*"Filming is necessary because it will validate the images authenticity. The film will show that the patient positioning was accurate, quality assurance and that the radiographer adhered to all the imaging procedures of patient care."(**FGD 2**)*

Sub-sub theme 2: Film reporting

The aspect of film reporting elicited a lot of debate among the participants. Three sub-sub categories were identified during the analysis. These include; agreement with radiographers reporting, controversy with radiographers reporting, and training as a requirement for reporting.

Agreement with film reporting

Some of the participants supported the notion that radiographers should undertake film reporting. Their views are expressed below.

"We have a very few radiologists with a lot of patients waiting for the film report from one radiologist so to reduce the pressure on one radiologist, radiographers should also

*be trained in film reporting especially on simple cases so that we reduce on the number of time patients spend waiting for the radiologist."(**FGD 2**)*

*"I support film reporting, especially on the part of patients who come referral from the rural hospital who may find that the radiologist is not around for maybe a week due to other commitments, you find that the films are taken to the clinic officers who don't have about the radiography films as compared to the radiographer."(**FGD 1**)*

Controversy with reporting

Whilst others supported the reporting role of a radiographer, some of the participants raised concerns with this role. Their thoughts are captured below.

*"It is ok but it has to come with some appropriate training on how to be done so that we don't just start doing things which are beyond the scope of our profession. But it's important to take into consideration because schools differ but at degree level, it's recommended that a radiographer is trained in film reporting."(**FGD 1**)*

*"The difference of the teaching methods in different schools results in differences in the knowledge that the radiographers have. Some schools teach film reporting while others do not, especially at the diploma level."(**FGD 2**)*

Training as an important element prior to reporting

Some of the participants placed a caveat on radiographers reporting. They noted that this could only be done where the radiographer demonstrates adequate training in the area of film reporting.

*"It is ok but it has to come with some appropriate training" (**FGD 1**)*

*"there is need some post-graduate training in film reporting in deferent specialities" (**FGD 2**)*

Sub-theme 3: Interpersonal competencies

During the discussion of the interpersonal competencies, two aspects emerged. The first was general agreement with the competencies as presented (Appendix 8). The second aspect was the lack of clarity on some specific elements.

Sub- sub-theme 1 Agreement with interpersonal role list

The participants agreed in general on interpersonal competencies. this is illustrated by some of the comments from the discussion.

*"I agree with the one saying a team player where because when we work as a team we can help each other in case one is not clear or too sure on something we can advise and remind each other as we consult from each other".(**FGD 1**)*

*"Participant F: team playing is very important because it helps us share information as we work... We can advise and remind each other through consulting each other."(**FGD 2**)*

Sub-sub theme2 Roles those were not clear

In spite of the general agreement, three specific areas were unclear for some of the participants. These were issues of; embracing cultural diversity, emotional intelligence, and multidisciplinary approach to patient care.

Cultural diversity

*"The last point value in cultural diversity, I am not clear with it." (**FGD 1**)*

Emotional Intelligence

The issue of emotional intelligence was not understood by some of the participants as illustrated below.

"asking for more understanding of what emotional intelligence is in this case." (**FGD1**)

However, during the discussion, some of the participants were able to articulate the meaning of the concept of emotional intelligence.

*"I think this has to deal with the radiographer practising empathy like you have to consider the feelings of the patients."***(FGD 1**)

"if am attending to the patients and another radiographer does something I don't feel is ok am not supposed to overreact in a way that will affect the patients' quality care. Therefore I need to use emotional intelligence and discuss that issue later when am done with the patient". (**FDG 1**)

Multidisciplinary

Some participants were unclear with the concept as shown below.

"When you say multidisciplinary approach, do you mean working with other professionals or something else?" ***(FGD 2)***

Sub-theme 4: Patient care competencies

With regard to patient care competencies, some participants were unclear with the issue of psychological care.

"How do we put a patient into psychological care? Because I was thinking like people to the psychological issues are the psychologists and psychosocial counsellors."

(FGD 2)

Fellow participants were able to provide clarity which allowed the participants to arrive at a consensus on the list. The clarity provided included;

"This simply means considering the what the patient is supposed to know by telling them this what is going to happen for such reasons (you are going to take off your clothes) so that they don't feel mistreated. Giving the needed information to the patients so that they are psychologically prepared for the incoming procedure." (**FGD 2**)

Sub-theme 4: Technical competencies

In this category of competencies, the unclear competency was equipment maintenance role of a radiographer. This was deduced following a question by a participant.

"may be just need clarity on the part of care and maintenance, what does it mean in terms of maintenance?" (***FGD 1***)

The consensus was reached following explanation by other participants.

"Maintenance of the equipment it's our role to draw up a program for the maintenance of the equipment." (***FGD 1***)

Sub-theme 5 Administrative Competencies

The points of controversy in this category were that of resource mobilisation and performance appraisal. This was evidenced following sentiments;

"on the case of resource mobilisation, what does it mean? Mobilisation of the financial resources, human resources it's not a role of the radiographer." ***(FGD 1)***

"the part of the appraisal, I don't think is part of the radiographer to do because it's the responsibility of the human resource manage unless where the HR gives authority such a particular radiographer." ***(FGD 1)***

In general, the other competencies under this category were acceptable to the participants as illustrated the following quote;

"I think they are the roles of the radiographer to give advice to the cleaner or our subordinates which is part of human resource management." ***(FGD 2)***

In addition to the listed competencies, suggestions were made to include leadership and directing.

"I would put Leadership and directing of radiography services on the topmost because this our core responsibility in the management roles and all the remaining roles fall into the services we are offering" ***(FGD 2)***

4.4.2.3 Rating of subordinates' technical ability

The participants of the FGDs were experienced radiographers. These radiographers were asked to rate the technical performance of their subordinates and provide reasons for their rating preferences. The Figure 4.21 below shows that the majority of the participants indicated that their subordinates' technical ability was low.

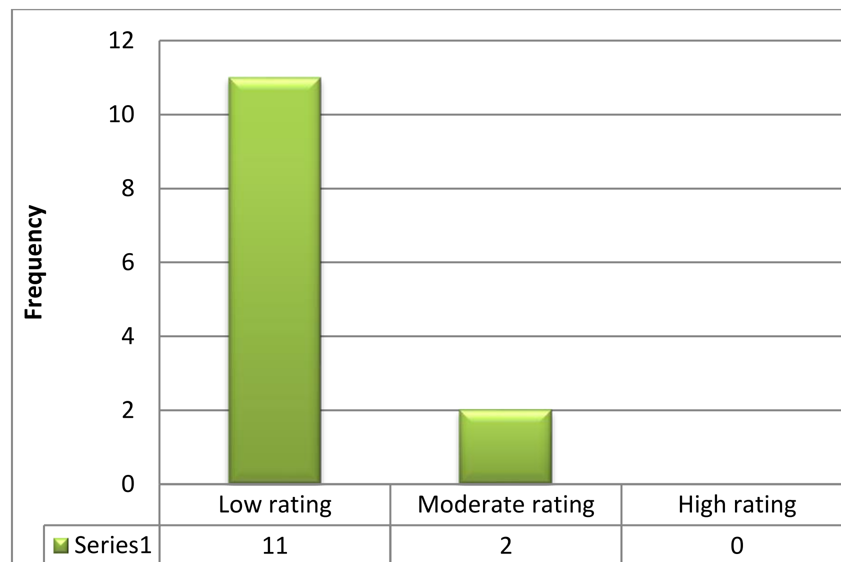

Figure 4.21: Rating of subordinate technical abilities

Low rating

Some of the reasons provided for the low rating included;

"what they produce is not up to standard and we are wondering what is happening to the schools where they are coming from these days." ***(FGD 2)***

"they have a lot of problems in the technical competence aspect and issues of interpersonal professional competences" ***(FGD 1)***

"below average out of 10 because of a few reasons because it has been quite challenging for them to give us what they know and what have done in their classwork.

Secondly, the feedback we get when these people go back is not good at the time only a very few people can implement what they done here. In addition, when you using a computer-aided machine, they still use the wrong technique even if the computer tells them what they are doing is wrong but they still do the wrong things. Poor techniques in the taking of an x-ray photo. For example, when I tried to review the images that were to be dispatched, I returned 90% of them because they were wrong as they may have been exposed or captured using wrong technique." (***FGD 2***)

Moderate rating

When the participants were asked for an explanation on their moderate rating of their subordinates, the following were some of the comments;

"they can't explain simple tasks and so you have to show them all the things they need to because they seem to be blank." ***(FGD 1)***

4.4.2.4 Rating of personal technical ability

The participants were also asked to rate their own technical competencies. The majority of the participants rated themselves highly as shown in Figure 4.22.

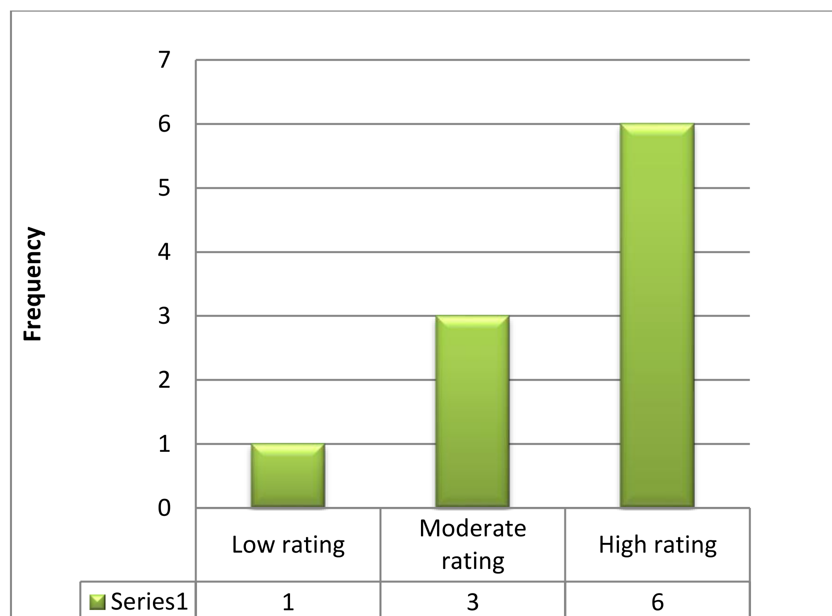

Figure 4.22: Rating of senior radiographers

Low rating

The reasons provided by the participants for the low rating included;

"there a lot of factors that we need to put in place for us to be effective. These factors include:

- *Sometimes we ignore important things because we have been in the profession for some time of which we do wrong.*
- *Compromising in a lot of things due to shortage and inadequate supply of other resources.*
- *The equipment does not facilitate to do the best in our work.*
- *The inferiority complex as the seniors request for something you have to do their request first which affects the results of our products. To avoid conflicts with the seniors even what they are telling should not be done at that time we compromise and do such which is wrong"*

(FGD 1)

Moderate rating

Some of the reasons advanced for the moderate rating included;

"this is just an amplified version of what radiographer should do and so I do them except for a few things that are new on the list and those I can't do for the reasons beyond my control." ***(FGD 1)***

"because most of the things I do them and I would rate them I with the resources available but maybe the participation of research I don't do much." ***(FGD 2)***

High rating

Participants who rated themselves highly provided some of the following as reasons for their selected rating options.

"because 3/4 of the things on this list I do them and a few things am not able to do it's because of the reasons my colleagues have mentioned." ***(FGD 1)***

"most of the QA things I do not do them and even at school, I use to emphasise that it is one of the most important things to do. I do almost everything in that but not all of them. In other areas now with the awareness and training I will do better." (***FGD 2)***

4.4.2.5 Rating of curriculum

With regard to the rating of the curriculum, three aspects emerged. These included; low rating of the curriculum and non-appropriate implementation of the curriculum, this is evidenced by the following quotations;

"it does not because the curriculum still contains things that are no longer being used in the system and when the students go out they find new things which affect their competences. The curriculum needs to be adjusted and use new things." ***(FGD 1)***

"the issue of the curriculum we have to look at who is implementing it, who is it meant for and what skills does it intend to produce? For me, it's not just the curriculum but these people and factors involved. When you look t the enrolment is poor such that you don't know who comes for practical or clinical practices. The clinical training is very critical in that during our time, everyone had clinical training but today those from colleges without materials and equipment to use for clinical practices in their schools. How do you expect to train someone like that? Therefore at the end of the day, the theory and practices are very bad." ***(FGD 2)***

4.5 Phase 4 results

This aspect of the study aimed at establishing how the TEVETA curriculum outcomes match the contemporary requirements and actual performance of graduates working in various levels of health service delivery in Zambia. In this respect, the job roles and competencies summarised from the first two phases of the study were compared to the curriculum competencies.

Analysis of the competencies revealed that 63 (70%) out of the 90 competencies were classified as lower-order cognitive ability using Bloom's Taxonomy of the knowledge domain. The psychomotor objectives accounted for 13% (n=13) of the total competencies as shown in Figure 4.23.

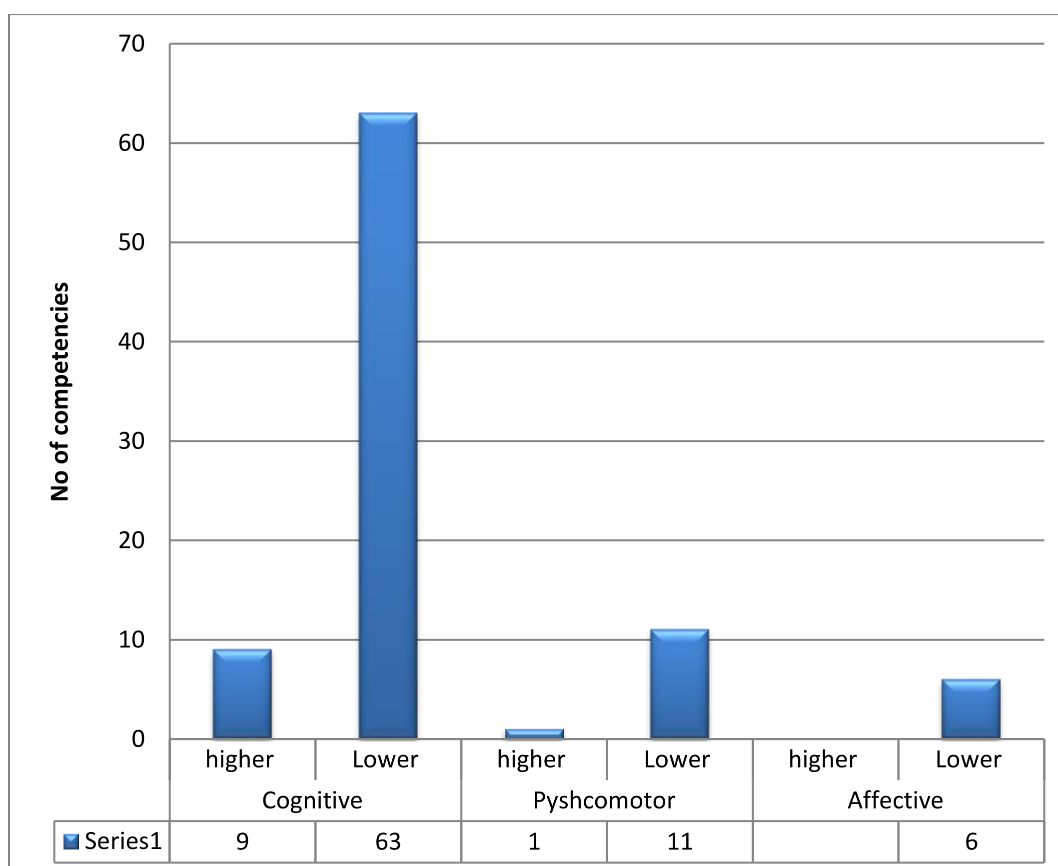

Figure 4.23: Distribution of the competencies in 2004 TEVETA radiography curriculum

Further review of the objectives was undertaken in order to align them with the proposed contemporary job competencies. The majority of the objectives (n=40) were aligned with technical competence. This was followed by administration and clinical care roles (21 and 15 respectively) (Table 4.27).

Table 4.28: Number of competences in line with generated competency list

Competence	Number	%
Technical	40	44
Administration /Mgt	21	23
Clinical	15	17
Patient care	6	7
Interpersonal	3	3
Professional	2	2
Research	2	2
Theoretical	1	1
Training/Education	0	0
	90	100

The focus of the current study was on the evaluation of the technical competences of practising radiographers. In order to interrogate this aspect mapping of the technical roles was undertaken. The results show that 55 out of 61 (90%) of the objectives in this category was dedicated to the technical knowledge required for proficient utilisation of technical equipment. Only 5 (8%) of the objectives addressed the issue of image quality. This is summarised in Table 4.28

Table 4.29: Technical roles represented in the TEVTA curriculum

Technical Role	Number	%
Image QA	5	8
Equipment Care & QA	1	2
Tech Knowledge	55	90
Technical Support		0
Patient Safety		0
Clinical Audit		0

	61	100

4.6 Conclusion

This chapter sought to present the findings of the study. These findings have been presented in line with the four objectives that directed the study. In the final analysis, the TEVETA 2004 radiography curriculum has the majority of the objectives that are lower-order cognitive ones that directed primarily at the technical requirement for utilisation of equipment.

CHAPTER 5 DISCUSSION

5.1 Introduction

This chapter presents a discussion of the major findings of the study. The main research question was 'How can workplace performance assessments inform curriculum development and attendant assessment practices to improve the concordance of radiographer training and job requirements of contemporary radiographers who graduated after 2010 from the TEVETA training programme?'. The approach taken in answering this question was:

i. To establish contemporary practice requirements for radiographers working in Zambia
ii. Assessing the competence of practising radiographers in one specific area (technical competence)
iii. Evaluating the TEVETA curriculum to establish if the contemporary practice and embedded in it and link the performance in WBA to the curriculum.

Ultimately, the goal was to establish if the outcome of WBA using a technical sufficiency exemplar could generate information for decision making during curriculum review. As noted by Prideaux (2003) (figure 2-2), information from the health sector can be used to improve the curriculum and training.

The discussion is presented in line with the result presentation. The demographics of the two sets of participants are discussed first. This is followed by the findings from the self-assessment and WBA. The findings from the consensus-building process are then discussed before amalgamating the discussion by linking curriculum evaluation to the other sections.

5.1 Demographic characteristics of the participants

There were two distinct sets of participants in this study. The first constituted practising radiographers with over ten (10) years of experience, while the second was radiographers' whose skills in clinical competence were being assessed. The second group had, on average less than two (2) years of work experience. Generally, they were more males than females in the first and second phase of the study. In surveys and studies conducted in Europe and United States of America (USA) the ratio of females to males is in favour of females (Schmidt, 2006, Reid, 2005, Payne, 1998, Edwards et al., 2009, Croissant, 1999). This demographic feature is in keeping with the characteristics of the participants of the third phase of the study which showed a slightly higher number of females than males. According to Anim-Sampong et al. (2018), the radiography profession has been dominated by females over the years. However, they note that in Ghana male radiographers account for 85.2% of all radiographers. This picture is similar to the overall demographic features in terms of gender for the current study.

In the Zambian context, the historical and cultural situation is that access of females to education opportunities have been less compared to their male counterparts (Mwanza, 2015). Furthermore, access to science-related training programmes by females has been hampered by social and environmental factors (Hill et al., 2010). These reasons may explain the picture portrayed by the female, male distribution in this study.

In terms of performance in the self-assessment of competence, the results indicate sex was not a factor in participants rating themselves. This was also true when an association test between competence and single variable analysis was done. However, in the regression model sex was found to have an effect on competence. Females had a lower odd of being competent compared to their male counterpart. It is inconclusive why such a phenomenon exists. However, one can speculate that if the radiography seen in Zambia

is male-dominated, then the female radiographers may be overshadowed by their male counterparts resulting in them failing to outshine them. It must be noted that the overall the competence levels is both male and female was relatively low, and as such the statistical significance in terms of odds cannot be overemphasized.

5.2 Evaluation of technical competence of radiographers

In the evaluation of technical competence, two aspects were investigated; actual competence using WBA and self-assessment (perceived competence). The underlining assumption was that how well these individuals performed can be linked to; training factors, legal requirements, and the curriculum (figure 2-7: conceptual framework). While appreciating the role that the other factors would have on competence, the focus was on the association with the curriculum.

5.2.1 Workplace Based Assessment

The performance in the WBA was used as a surrogate for assessing competence. In this study, such an approach was taken as a method to obtain a true reflection of the competency level of radiographers in one specific area of practice; technical evaluation of chest x-ray. The goal was to establish the level of competency and compare this to stated curriculum outcomes. The rationale was to ascertain if this process can yield information or evidence to support or maintain the curriculum component that deals with image quality assurance.

It has been argued that the assessment of competence at the “does” level in Miller‘s pyramid can be best done in a work or clinical environment. The level of competency at the “does” level in some cases can only be achieved once a student has graduated and is in practice. One might extrapolate that at the level of the undergraduate final examination, the assessment practice may fail to yield proper determination of “does” competency

(Van der Vleuten et al., 2010, Singer, 2016, Sathekge, 2017). The assessment of individuals in actual clinical environment coined as WBA allows for the assessment of "does" competency level (Norcini, 2003).

The technical sufficiency assessment was restricted to the evaluation of a five (5) chest X-rays. This assessment was based on an evaluation of seven factors; anatomical coverage, positioning, film exposure, contrast, sharpness, image annotation, and radiation protection. The assessment of competency in each category was established by comparing the score to a predetermined standard score within a margin of +/-2. Overall competency was taken to be +/-2 of the aggregate performance with relation to the predetermined standard score. This approach of establishing competency using a Likert scale has been used by (Jackson, 2007).

The competence levels of radiographers in this study were rated relatively low. This is at variance with the other studies noted above. The difference might be attributed to the method of assessment. The approach taken in the other studies was a subjective global rating of radiographers. Our approach utilised an objective assessment of the performance of each participant in the study. Another reason for the noted variation could be the use of a snapshot assessment where a single assessment is undertaken in a few hours. Several assessments of the same individual over a long period can yield a more valid verdict of competence.

Assessment of radiographer competency was undertaken by (Vanckavičienė et al., 2017) for radiographers in Lithuania. In their study approach, they used self-rating approach and compared to radiologist rating of radiographer competence. They found that the rating of the technical capabilities by both the radiologists and the radiographers themselves was relatively high. In a self-rating study of both clinical care and technical radiographic processes conducted by Andersson et al. (2012b), they found a similar high rating of

technical skills. Similar findings were also found by (Mackay et al., 2008b) when the readiness of newly qualified radiographers was assessed.

Other studies that have assessment individual competence of radiographers have mostly dealt with capacity in role extension. Most of such studies have concentrated on film reporting (White and McKay; 2002, Law et al., 2008; Jones and Manning, 2008; Cascade et al., 2001; Brealey et al., 2009). These studies have compared the radiographer performance against radiologist and have concluded that the specificity and sensitivity of the radiographer reports were acceptable. Similar studies in Africa have also found comparable results. Furthermore, there is general agreement that radiographers can perform these roles to acceptable standards (Kekana et al., 2015; Du Plessis and Pitcher 2015; Gweta, 2012; Williams, 2009; Kawooya, 2012) The inference that can be drawn from such studies could be that where a radiographer can report on a radiograph appropriately, his/her capacity to evaluate a film for quality is also acceptable. Therefore, we can assume that the radiographers' competency with regard to technical film evaluation was at a high level. The contrast in terms of comparisons with the participants in the current study is that those that were included in film reporting studies had extra training or longer experience in film reporting (Woznitza et al., 2018; Sonnex et al., 2001; Piper et al., 2014).

On average, the participants in this study were not competent in the assessment of anatomy, positioning, film exposure, film contrast, and sharpness. The issue of retention of information after it has been taught has been investigated in many settings, In radiography the ability of student radiographers to remember anatomical science was investigated by Hall and Durward (2009), they found that the students ability to recall anatomical facts when assessed over a time period of ten (10) months apart, declined. Such a finding has also been reported by scholars in other fields (Sullivan et al., 2013; Ling et al., 2008). The exhibition of low competence in the cohort of this study may be

attributed to; the low retention as noted by the other scholars, the curriculum emphasis, and the assessment practise.

A review of the assessment practises in the Zambian radiography training shows that assessment of practical skills is conducted infrequently (mostly at the end of the third year). This once of assessment may result in an inaccurate assessment of practical skills. Such a practice may not be compatible with the requirements of a profession that is very practical in nature. Furthermore, the practical examination is restricted to a student performing a radiographic examination on one patient. In a review of the practice across Europe, Burchell et al. (1999) reported that training institutions conducted at least six (6) summative clinical assessment in a three-year training programme. The use of Objective Structured Clinical Examination (OSCE) helps to provide content validity to the assessment process (Marshall and Harris, 2000). Such approaches could explain why the competence level was found to be higher in studies conducted in the European region compared to that in the current study.

When a connection is made to the findings from the evaluation of the curriculum, the number of competencies dedicated to technical sufficiency in terms of image evaluation is very low. The low levels of technical competence in our study could be explained to some extent by this.

5.2.1.1 Interplay of variables with a competence level

In trying to explain the low levels of competence, exploring other factors not necessarily associated with curriculum and training was also important. A cross-tabulation using Fisher’s exact test was undertaken with a view of measuring an association between competence and the other variables. The variables in question were a hospital, sex, years of experience, and the number of chest x-ray performed. This initial analysis did not show a significant correlation between the variables and competence. The implication,

therefore, would be that competence was much more related to factors associated with training and not the actual work environment post-training.

In a study conducted by Wolff et al. (2010) on new graduate nurses practice readiness they noted that competence building takes a trajectory path with the entry point being fundamental competence that allows one to practice. The higher-order competencies build with time. This assertion was also highlighted by other studies (Lima et al., 2014; Kajander-Unkuri, 2015). Against this background, an underlying assumption at the start of the study was that participants with more years of experience and working in hospitals with a high turnover rate of patients would exhibit high competence levels. It was, therefore, suppressing that years of experience and frequency of performing chest x-rays did not translate into higher competence standing. It must be noted, however, that the graduates in this study were divided into two distinct years of experience category, those with less than one (1) years and those with one to two years' experience. The difference in terms of experience may not be that much. Another factor that might explain the noted discrepancy could be that, the participants with more experienced had spent more years away from an academic environment before starting work. This gap can be can be linked to loss of recall of factual information related to specific technical issues.

The influence of the hospital setting was also viewed as a factor that would influence competence. This assumption was based on the fact that hospitals with higher patient turn over, a larger complement of senior radiographers, and those that perform a high number of chest x-rays would have graduate radiographers that are more competent. As highlighted in the foregoing, this was not the case. The study did not collect data concerning hospital staff establishment and actual patient turnover rate. This was, therefore, not incorporated in the statistical analysis. However, anecdotal information is that some hospitals did have staff establishment with more seniors and had a higher patient turnover. The finding in this study does correspond with other studies in

radiography, specifically in film reporting. The assumption that previous experience can influence a radiographer's ability to accurately interpret a radiograph was tested by Piper et al. (2014). They found that there was minimal difference between groups of varying experience concerning their ability to interpret radiographs.

The interplay of variables was further tested in a correlation matrix. The frequency with which a participant performed chest x-rays was correlated with, a high self-assessment score, Anatomy score, exposure score, sharpness score and contrast score evaluation. The implication of this is that individuals who performed more chest x-rays tended to be more confident of their ability and correspondingly their performance on the assessment was higher. The subject of self-perception versus actual competence has been investigated by several people. Some studies in medicine have looked at student competence. Katowa-Mukwato and Banda (2016) noted that medical students' perception of competence and measured competence in clinical skills were at variance. The student rating was actually higher than the actual performance rating following an objective assessment. Even though the setting is different in terms of the participant characteristics, this finding is consistent with the observation made in the current study.

5.2.1.2 Predictors of competence

There is a paucity of literature on predictors of competence among newly qualified radiographers. Some studies have been undertaken to identify factors that influence the competence of healthcare professionals. Istomina et al. (2011) noted that for nursing; nurse education, experience, professional development, independence, and work satisfaction, as well as the evaluation of the quality of nursing care, were identified as factors associated with nurse competence. In a study by Wangensteen et al. (2012), the predictors of competence among nurses were gender, university education, healthcare experiences, work area, and critical thinking.

The final regression model identified sex and self-perception as the predictors of competence for the cohort in this study. Other factors considered such as age, years of experience, and the type of hospital in which the radiographer practice was not a significant predictor of competence.

The regression model also points to the fact that factors post-training had minimal influence on the competence levels of the participants. This again strengthens the argument that factors associated with training are more important. The justification to ensure a rigours evidence system to generate information for curriculum improvement is thus strengthened.

Furthermore, opinions of supervising officers in our study that the radiographers who graduated post-2010 have the lower technical ability are supported by the apparent low levels of competence measured using our WBA. This further illustrates the value WBA can have in generating evidence to support or criticise current training approaches.

5.2.1.3 Role of WBA in Curriculum evaluation

When a comparison of the performance of individuals in the WBA was analysed, the indications were that the level of performance was relatively low as has been discussed. Furthermore, curriculum evaluation showed that minimal emphasis is placed on this requirement for practice. Admittedly, it is essential to note that a difference exists among the following factors, what is learnt, what is taught, and what is planned in the curriculum. Therefore, the absence of objectives related explicitly to technical film evaluation does not imply that these aspects are not taught or learnt as they might be parts of the hidden curriculum of a programme (Harden, 2001). However, the observed low competence level may be indicative that such skills were neither taught nor learnt during the course of study. However, where absence is noted in a curriculum, assessment of individuals' competence in the absent competences yields acceptable competency level if such skills were learnt.

5.2.2 Rating of radiographer performance

One of the objectives of the study was to establish the rating of the job performance of the radiographers who graduated post-2010. This aspect was viewed through two (2) lenses, the first being the view of supervising officers and the second through the radiographers themselves. Generally, the supervisors viewed their subordinates' competence as low. On the other hand, the radiographers viewed themselves relatively higher in terms of their ability to perform on the job.

A study conducted by Vanckavičienė et al. (2017) in Lithuania, they found that rating of the competencies of a radiographer by radiologist and radiographers themselves was generally high. In a study conducted in Sweden, on self-rated radiographer competence, the findings were that radiographer rated their patient care and technical capability generally high (Andersson et al., 2012b). The common element in the studies (including the present one) is that self-rated performance is typically high. This might be attributed to the fact that individuals once qualified and is employed to perform a task would consider themselves as competent. In our study, the perception by the supervising officers was contrary to the self-perception. This situation is different from that portrayed in the study by Vanckavičienė et al. (2017) the difference between the situations could be attributed to a vigorous effort in the European case to not only review curriculum but also monitor the adequacy of implementation.

It must also be noted that the self-assessments conducted in the other studies was much more comprehensive. In the current study, the assessment was limited to the radiographers' capabilities to evaluate a film for quality. While other studies have demonstrated the benefits of self-assessment, in our study perceived levels of competence was at odds with the actual level of competence. Hoorens (1993), notes that individuals tend to rate themselves highly when asked to assess the capabilities. This is sometimes

referred to as illusory superiority. The higher self-rating in this study can be attributed this.

The implication, for the current study, would be that relying on self-assessed competence my not provide accurate information that can be used for curriculum improvement. The actual performance measurement if reliable would be more realistic for the Zambian setting.

5.3 Consensus on radiographer competencies

The main objective of the study was to establish how to useful WBA can be to informing curriculum review decisions. However, other pertinent information required in the overall review was also interrogated. This included firstly a description of who a radiographer is and then the competencies of such an individual. Such information was required to solidify the technical sufficiency competence to be assessed and further to gather information needed to make an overall judgement of the TEVETA curriculum. In this regard, a discussion of the resulted related to these two aspects is presented below.

5.3.1 Overall job description of radiographer

According to Couto et al. (2018), the training and practice of radiographers worldwide vary considerably. If this positioning is correct, then consideration must be given creating a contextual description of the overall job description of radiographers practising within each country. The consensus description of the overall job description of a radiographer working in the Zambian public health sector; from the first and second phase of the data collection process of this study was "The primary role of radiographers is to assess patients and their clinical requirements in order to apply the appropriate radiographic techniques; pursuant to producing Images of diagnostic value, furthermore, to undertake additional roles that enhance radiography service delivery subject to appropriate

training". This description underpins three fundamental requirements: need to be aware of the patient condition before embarking on an imaging procedure; undertaking an appropriate imaging procedure, and finally adding value to the imaging process by providing services that ensure a complete service is provided.

The additional roles may include image interpretation and research. Previously, these additional roles were considered to be beyond the scope of practice of radiographers; hence performance of these functions was considered as role extension (Cowling, 2008, Björkman et al., 2017). The consensus among the participants of this study for extending the primary description is in keeping with trends across the world were radiographers are considered to be not only producers of medical images for diagnosis but members of a clinical team that effectively contributes to clinical practice, management, leadership, research and education as noted by the Society of Radiographers (SoR) in the United Kingdom (UK) (SoR, 2019b).

It must be noted that although the argument to extended roles is valid, it must be undertaken with appropriate educational training and a change in the legal framework to allow for extended scope of practice (van de Venter and ten Ham-Baloyi, 2019). The situation in Zambia where only a few radiologists are available, the call for extended roles such as film reporting may provide a means of improving health service delivery by ensuring that imaging services are completed in a one-stop environment (Munsanje, 2014). This justification for role extension by the participants of the current study may, therefore, be valid. This is in keeping with the international society of radiographers and radiological technologists (ISRRT) policy statement which affirms that added roles such as film interpretation are within the realm of radiographer practice provided adequate training is undertaken (ISRRT, 2019).

With regard to our study, the agreed description implied that the need for a radiographer to be technically competent was important. This can be drawn from the part of the description that stresses the need to ensure the production of an image of diagnostic value.

5.3.2 Consensuses on job roles and competencies

The competency categories consolidated from the first and second phase of the study outlines nine (9) categories these being: Technical, Professional, Clinical, Interpersonal, Patient care, Administrative/Management, Theoretical, Training/Education, and Research. In the development of a psychometric tool to evaluate competencies (Andersson et al., 2012a) summarised radiographer competencies into eight (8) thematic areas, these being; Organization and leadership, Practical performance, Guidance and communication, Helping and supporting the patient, Vigilance, Internal and external collaboration, The medical image, and Quality Improvement. Even if the naming of the competency categories varied to that summarised in the current study, similarities are very evident. In-depth review of the subcategories outlined by Andersson et al. (2012a) was aligned with those of our study. In discussing the results in this section of the findings, the emphasis was placed on the technical competence because the WBA was anchored on this aspect.

5.3.2.1 Technical

Radiography is considered to be a profession that relies on the use of high-end technology in the production of high-quality images (Reeves and Decker, 2012). A radiographer must navigate between offering human care to patients and utilising technical equipment to answer clinical questions required to make a diagnosis (Murphy, 2006; Andersson, 2012). The technical skills extend beyond the use of equipment in image production but to apply technology to assure image quality.

Quality assurance is an integral part of imaging services. In some countries, it is a statutory requirement (Périard and Chaloner, 1996). The International Atomic Energy Agency (IAEA) recommends that a quality assurance programme should be set up for any radiology department. To this end, a tool for assessing quality has been established. The tool is called the Quality Assurance Audit for Diagnostic Radiology Improvement and Learning (QUAADRIL). This audit tool is meant to evaluate all aspects of service provision within a radiology department (IAEA, 2010). This study found that the technical competencies/roles were considered to be an essential part of the work-life of a radiographer. Following the review of the IAEA, ISRRT and SoR requirements, the views of the participants concerning the technical competencies of a radiographer are well-considered.

The technical evaluation of an image might be considered to be cross-cutting in the sense that the different categories, professionalism, clinical etc. are hinged on the production of a good radiograph. In reviewing the other subcategories these factors are evident. Recurrent themes such as adherence to standards, quality improvement, quality assurance, and radiation protection are found in Professional, Clinical care, Patient Care, and Administrative categories. Such findings augmented the stance that evaluating technical competence would also provide evidence of other competence categories.

Evaluating a resultant radiograph for quality is one of the final steps engaged in before dispatch or interpretation of an image (Mraity et al., 2014; Mount, 2016). It can be said to be the last checkpoint for the overall quality of an imaging system (Larsson et al., 2013). The use of WBA in the quality evaluation was, therefore, a justified method of addressing competency assessment. The consensus by the radiographers that technical competence should be included on the list of competencies required of a radiographer working in Zambia was thus critical. Furthermore, this added to the justification of using

this area as an exemplar for establishing the suitability of WBA in informing curriculum decision making.

5.3.2.2 Other competence categories

Professional competencies

Practitioners in the health sector have considered themselves as professionals. This steam from the fact that a profession is not only seen as a field of study but also the application of the ethos of that field for the benefit of others (Ehrlich and Daly, 2009). Further to this, professions are organised to self-regulate through the enactment of profession-specific codes and ethical conducts. In the case of radiographers, it is essential that if radiographers are to be considered as a body of professionals, they must exhibit tenets of professional conduct.

In this study, competencies and roles aligned to this category were established during the data collection and included: observance of codes of ethics and conduct; affiliation with the professional body; compliance with regulatory and legal provisions; and continued professional development. The ISRRT places emphasis on practising radiographers to ensure adherence and alertness to the laws, regulations, standards, and codes that govern radiographic practice in his/her particular jurisdiction (ISRRT, 2019). The Society of Radiographer (SoR) the UK has also issued a professional code of conduct which has four (4) sections; relationships with patients and carers, the scope of practice, personal standards in professional practice, and relationships with other healthcare staff. These sections have several policy statements that guide practice in UK (SoR, 2013).

Clinical competencies

The SoR describes a radiographer as an individual who employs a variety of safe and accurate techniques to produce high-quality images to diagnose an injury or disease (SoR, 2019a). SoR further notes that where policy and education exists, radiographers can

provide image interpretation. In the current study, the most cited clinical roles by participants included; image production, practice in accordance with standard operating procedures, undertake film reporting and ensure radiation protection. These coincide with the description provided by both the ISRRT and SoR.

Whilst in the current legal framework in Zambia, reporting by radiographers is not considered as a primary, participants in the study emphasised the need for the repeal of the policy to support this function. Studies conducted have demonstrated that radiographers with adequate education can perform the role of film reporting to a standard that is appreciable. This is against a background where the shortage of radiologist is set to continue for the foreseeable future (Woznitza et al., 2014; Woznitza et al., 2018; van de Venter and ten Ham-Baloyi, 2019; SoR, 2019a, Snaith et al., 2015; Sloane and Miller, 2017).

Radiographers, in most instances, use ionising radiation in the image production process. The dangers of ionising radiation have been well documented (Joiner and Van der Kogel, 2016; Hall and Giaccia, 2006; Bushberg and Boone, 2011). It is, therefore, crucial that the radiographer in the performance of his/her duties should pay particular attention to the principles of radiation protection (Talab et al., 2016). In line with the consensus in the literature, the clinical roles agreed on by the Zambian radiographer fraternity are justified.

Interpersonal competencies

The nature of health professions practice is that contact with other individuals is unavoidable. The execution of a radiographer's function relies to a large extent on the cooperation of the patient and other health professions (Ehrlich and Daly, 2009). The inclusion of this category by the study participants is, therefore not misplaced.

According to Brown (2004), radiographers are an interface between patients and clinical care experts and as such, should possess interpersonal skills that can assist them in

navigating such complex relationships. The roles identified in our study included; working in a multidisciplinary approach, being a team player, practice emotional intelligence, and effective communication with patients and staff. These roles and/or competencies have been identified as critical requirements for health practitioners (Stein-Parbury, 2013; Mackay et al., 2012; Kubik-Huch et al., 2010; Kelley et al., 2014; Jorge and Scheller, 2014; Grant and Bach, 2009). The inability of healthcare personnel to effectively apply interpersonal skills can result in compromised healthcare outcomes (Kelley et al., 2014). The lack of comradeship amongst healthcare workers have been investigated, and some causes of interprofessional conflicts identified include tribalism and culture, and a lack of understanding (Strudwick and Day, 2014).

Patient care

It can be argued that healthcare workers exist for the so purpose of providing a service to patients and clients in need of healthcare. Therefore, care for these individuals must account for a significant segment of healthcare workers energy. The precise definition of what care is may be difficult to articulate (Bolderston et al., 2010). Among the descriptions provided, one that embodies radiography practice as cited by Bolderston et al. (2010) is; "Providing emotional support, explaining the procedure in a manner the patient can understand, permitting the patient to express emotion, actively listening to a patient's concerns and responding in an empathetic manner and recognising the patient as a unique individual rather than just another case.". The components of the description are similar to the consensus reached in the current study were some of the elements in this category included; patient comfort, safety and security, information provision and consent, psychological care, and ensuring holistic care approach.

Hellman and Lindgren (2014) reported that patients in a radiology setting require information, physical and psychological care, and individualised attention. In addition, a radiographer's ability to be alert to these requirements, have a significant effect on the

output of a radiographer- patient encounter. Therefore, the assertions of the participants in this study concerning patient care can be said to be well-founded.

Administrative/Management

According to Kreitner (2009) "management is the process of working with and through others to achieve organisational objectives in a changing environment". Kreitner further adds that this use of individuals must effective and efficient in the face of limited. The organisational structures of most radiology departments are such that positions are created in a hierarchical fashion to allow for the supervision and implementation of a smooth workflow. If this assumption is taken to be the correct approach in the management of such departments, then at any level of operation a radiographer will be charged with the responsibility of managing resources. These resources may be material and/or financial and human resources. As such these individuals must have skills and competencies that allow them to fulfil this role. Forbes and Prime (2000) report that the need to establish a formalised organisational structure which entrenches radiographers as service point managers were realised by the National Health Service (NHS) of the UK in the 1900s.

Thompson and Henwood (2016) undertook a study to establish the lived experiences of radiographers that had transited into managerial roles from clinical function. They found that when such transitions occur, a support structure must be created to allow them to become effective managers. The foregoing underpins the fact that radiographers need to be equipped with administration and management skills as has been suggested by the participants in the current study.

Training/Education

Radiographer training models across the world are designed in such a way that students spend a considerable amount of time in clinical sites practising. The link between theoretical exposure and actual practice is bridged in the clinical site with clinical

radiographers playing the role of mentor/teacher in the apprenticeship relationship. Inevitably, radiographers working in hospitals used as clinical training site usually have a duty to teach (Perram et al., 2016; Knight, 2018; Francis et al., 2016; England et al., 2017; Cunningham, 2015).

In addition, the rapidly changing face of radiography practice requires that radiographers engage in Continuous Professional Development (CPD). The implication of this is that skill transfer is a regular feature between radiographers. Hence education facilitation is not limited to the radiographer-student relationship but radiographer-radiographer relationships (SoR, 2007).

The inclusion of training/education as a separate category by the participants in this study sought to highlight the importance attached to this aspect of care. Furthermore, the Health Professions Council of Zambia (HPCZ) requires each practitioner to demonstrate CPD activities for them to remain on the register of practitioners. In addition, it is an obligation for incumbent practitioners to teach new entrants in any field of medical practice (HPCZ, 2014).

Research

The concept of research being a competence area in radiography was one of the new categories proposed by the study participants. Arguments may be presented as to the exact role a diploma radiographer may play in the research process; however, what is clear is that the appreciation of the research process is vital. This comes against a background where these individuals may participate in data collection. In addition, the drive to use evidence-based practice demands that the radiographer must be at the very least capable of comprehending the process of evidence generation and evaluation (Hafslund et al., 2008).

In studies conducted, evidence points to radiographers accepting this role as a part of their job profile (Vikestad et al., 2017; Reid and Edwards, 2011; Reeves, 2008). Nightingale (2016) in an editorial comment notes that there is an increase in the quantity of research that is currently being conducted by radiographers as evidenced by the increased publication and submission for publication of original radiographer research work. Malamateniou (2009) further notes that the number of radiographers attaining postgraduate qualification has also increased signifying an increase in research activities. Therefore, the inclusion of this category should be encouraged, especially with the Zambian scenario were only a handful of publication in peer-reviewed are accredited to Zambian radiography authors.

5.4 Curriculum evaluation

The review of a curriculum sits within the framework of programme evaluation. The goal of any programme evaluation is twofold to evaluate process efficiency and output (McNeil, 2011). The aim of the curriculum review in the present study was to access the programme output. McNeil (2011) proposes a twelve (12) step process which begins with identifying the purpose and context of the curriculum, and the setting in which designed. It is also essential to identify the cognitive, psychomotor and affective requirement of the training programme the curriculum is intended to deliver before an evaluation of a curriculum is embarked on (Merritt et al., 2012; Harden, 2001). This helps to put into perspective the pitch in terms of the level of training.

The TEVETA curriculum for radiography is rated as a Level six (6) on the Zambia National Qualification Framework (ZAQA). This sets the qualification at the mid-range of the hierarchy, which ranges from one to ten, with ten being the highest. According to the Ministry of Science, Technology and Vocational Training (MSTVT) policy, this level

of training is meant to produce trainees that have advanced technical knowledge (MSTVT, 1996).

The 2004 radiography curriculum outlines the programme goal as "to supply the health care delivery services in imaging with Radiographers that are adaptable to varying service provisions without compromising on the technical quality of the profession". The aim is that the radiographers develop Knowledge, Skills and attitudes required for the practice of the profession. Using Bloom's taxonomy, Dreyfus' and Krathwohl's models, the radiography curriculum evaluation revealed that the curriculum objectives were mostly around the lower cognitive levels. The skills level objectives were few and set at the address the lower order abilities. When this is compared with the TEVAT policy and the rating of the training on the ZAQA, one is lead with the conception that a mismatch has occurred. Furthermore, there is a requirement by ISRRT and other radiography bodies (SoR and ASRT) for radiographers to be highly competent individuals who should contribute to improving imaging service delivery. In an instance like the Zambian situation where the training objectives set at addressing the lower order abilities, it may bring about a questioning of the fitness for purpose of the Zambian trained radiographers.

It must be noted that across the world, the training of radiographers has been elevated from three-year diploma programmes to four and five-year degree programme (Price, 2009; Pratt and Adams, 2003; Cowling, 2013, Cowling, 2008; Couto et al., 2018). This may account for the higher expectation in terms of practice requirement. On the other hand, Zambian trained radiographers have traditionally been allowed to register to practice using their Zambian qualification across the world. Therefore, one might argue that even at diploma level, the complexion of the training must mimic or reflect the international requirement for practice.

5.5 Conclusion

The discussion of the findings was set around the study questions which were aimed at drawing consensus of job roles/competencies, rating of global radiographer performance, evaluating technical competence in specific and evaluating the curriculum. The reviewed literature did not reveal significant information relating to the use of WBA in informing curriculum review practices in radiography. The overarching goal was to establish if WBA can improve the quality of the curriculum review process. Results from the analysis of the data were compared with practices around the world to show similarities and difference. The study conclusion and recommendation are presented in the concluding chapter.

CHAPTER 6 CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The study sought to answer the question ‘How can workplace performance assessments inform curriculum development and attendant assessment practices to improve the concordance of radiographer training and job requirements of contemporary radiographers who graduated after 2010 from the TEVETA training programme?’. This question was posed following a problem analysis that found that a possible mismatch exists between the contemporary requirement for practice and readiness for the practice among Zambian trained radiographer owing to static curriculum review on one hand and fast-changing technological and practice change on the other.

Specifically, the objectives set were to:

i. To establish the contemporary job competencies for diploma radiographers working at the various levels of health service delivery in Zambia.

ii. To analyse the extent to which post-registrations radiographers who graduated from the TEVETA radiographer training programme between 2010 and 2015 are meeting the job requirements of a radiographer for primary, secondary, and tertiary care in Zambia.

iii. To evaluate the competency levels of post-registration radiographers who graduated from the TEVETA radiographer training after 2010 in plain x-ray technical sufficiency assessment and correlate with their self-perception.

iv. To establish how the TEVETA curriculum outcomes match the contemporary requirements and actual performance of graduates working in various levels of health service delivery in Zambia.

This chapter outlines the main findings of the study; conclusions are drawn, limitations and strengths, implications for practice, and the areas for future research.

6.2 Major findings

The findings are summarised in relation to the objectives set for the study. The main focus of the study was to establish what role WBA can play in proving curriculum development and review practice. This related to object number three (3). The findings in relation to this objective and that related to self-assessment of competence are presented first.

6.2.1 WBA summary findings

The majority (76%) of the participants of the WBA, were categorised as 'NOT COMPETENT' in the technical evaluation of chest radiographs. This none competence rate was considered to be too high. This is again a background that plain chest imaging is one of the most commonly performed investigations in most radiology departments. The only subcategory where those competent to those not competent was almost equal was in the field of assessment of image annotation. The outcome from the WBA is in agreement with the assertions of supervising officers that the current crop of newly qualified radiographers' (post-2010) competency level is relatively low.

From the regression model, the predictors of competence among the participants were sex and self-rating of competence. This pointed to the fact that issues like hospital setting, equipment utilised, clinical exposure and years of experience were not significant predictors of competence.

6.2.2 Self-assessed (perceived) competence summary findings

There was a high self-perceived competence level. The mean score for self-evaluated competence was 76%. This finding was at variance with the supervisor's perception of

their abilities. This variance points to a possible miss-joint in clinical practice approaches. Questions that arise include; are the seniors not supervising or providing mentorship to the new crop., Are mentorship programmes in place in the current institutions, Is there a system of quality assurance that enables a learning environment for skills improvement, and are continuing medical education activities being provided to the newer generations of radiographers.

6.2.3 Summary of contemporary competencies

The job roles/competencies for the Zambian radiographers are divided into eight (8) categories Professional, Clinical, Interpersonal, Patient care, Technical, Administrative/Management, Training/Education, and Research. Some of the specific competence can fall into several categories. These categories are in line with international requirements for the practice of radiographers. The detailed competence list is provided in appendix eight (11). Some of the specific roles/competencies were attributed to more than one category.

The professional competences relate to those job roles that border on professional and personal growth, qualification to practice, and adherence to codes of conduct and ethics. These roles/competencies are designed to ensure that a radiographer is considered a professional in his dealings with the patient, other staff members and the public at large. In addition, they provide a sense of accountability for one's actions as a radiographer (Ehrlich and Daly, 2009).

The clinical category outlines issues directly related to imaging service provided directly to a patient. Emphasis is on factors to consider when performing imaging services such as performing procedures in accordance with set protocols. The category of patient care is related to the clinical classification. The point of departure in this category is the emphasis on patient comfort and respect for the rights as individuals.

The interpersonal category consists of roles that relate to improving service delivery by ensuring a holistic approach using a multidisciplinary approach. The underlying concept is that radiographers need to utilise emotional intelligence to ensure the achievement of institutional goals (Stami et al., 2018; Mackay et al., 2012; Lewis et al., 2017).

The technical category underscores that requirement to be technically proficient in working with the machinery and technology in current use in medical imaging. Furthermore, the clinical aspects of quality, such as image quality management are also included.

The sixth category represents the requirement to managed resources. These resources management skills relate to both material and human workforce.

Training, education and research are modern requirements for practising radiographers. These indicate the need to ensure evidence-based practices and transfer of the essential skills to coming generations of radiographers (Malamateniou, 2009).

6.2.4 Curriculum evaluation summary findings

The last objective required that a link between the technical performance of radiographers and the current curriculum is investigated. The curriculum evaluation revealed that the objectives that relate to technical competence were very few, and most of them addressed only the lower order skills ability.

6.2.5 Overall finding

The main research question sought to examine the usefulness of utilising WBA in informing curriculum development/review practices, The process undertaken during the implementation of this study demonstrates that WBA assessment outcomes can be an essential source of information for curriculum review or development.

6.3 Implication of the findings

The implications are summarised with regard to requirements for radiography practice, and curriculum developers (faculty/institutions).

6.3.1 Radiography practice

In an era where support for extended roles for radiographers is being advocated for, it is imperative that the basic role of image production and quality assurance should be strengthened. Results from analysing just one aspect of the practice are indicative of low competence levels in the technical evaluation of images. This situation may compromise the stance of radiographers wanting to extend their roles into areas like film reporting.

6.3.2 Curriculum developers

The low levels of competence exhibited in the study should serve as an indicator of the quality of training being provided. in this regard, the methods of teaching, and assessment throughout the radiography training needs to be continuously evaluated to ensure that the outcomes of the assessment of clinical competencies are thought to be reliable and valid. The issue of inadequacy of the curriculum also has to be addressed. Ultimately, where the competence of radiographers is doubted, this raises questions of the quality of service provision which may have a direct impact on the health outcomes of those seeking radiological services in Zambian healthcare facilities.

In terms of curriculum development, the inclusion of multiple sources of information required in the making judgement calls during curriculum review or development should be given serious consideration.

6.4 Proposed framework for curriculum review

It must be noted that the goal of a curriculum evaluation process is to make the curriculum better in terms of how it responds to societal problems (Paul Griffin, 2010). Furthermore, the curriculum must prescribe efficient and cost-effective teaching methods as well as assessment practices that can ensure attainment of stated objectives.

Arising from the conclusions drawn from the study, a framework for data collection requirement for skills-based training programmes has been proposed (Figure 6.1). This framework borrows from the Stufflebeam's CIPP model of evaluation. The CIPP model emphasises on an evaluation addressing the components of a training programme. these include, context, input, process and inputs.

Information sources that can inform the context evaluation can include, international conventions that govern practice, changing trends in the international practice requirements, local industry requirements, local policy and legal requirements and curriculum mapping activities. With regard to the Input and processes, data from teaching staff (academic and clinical, current students, graduates, and industry/clinical managers. Information about the product (graduates of the curriculum) the use of WBA assessment as demonstrated in this study can be very useful. other sources of information may include graduates and industry/clinical managers.

6.4.1 Three pillar information gathering framework for curriculum evaluation

The framework proposes three fundamental information sources that must always be considered when determining if changes should be made to a curriculum should be made. These are competency practice requirement, training programme evaluation, and assessment of graduate performance.

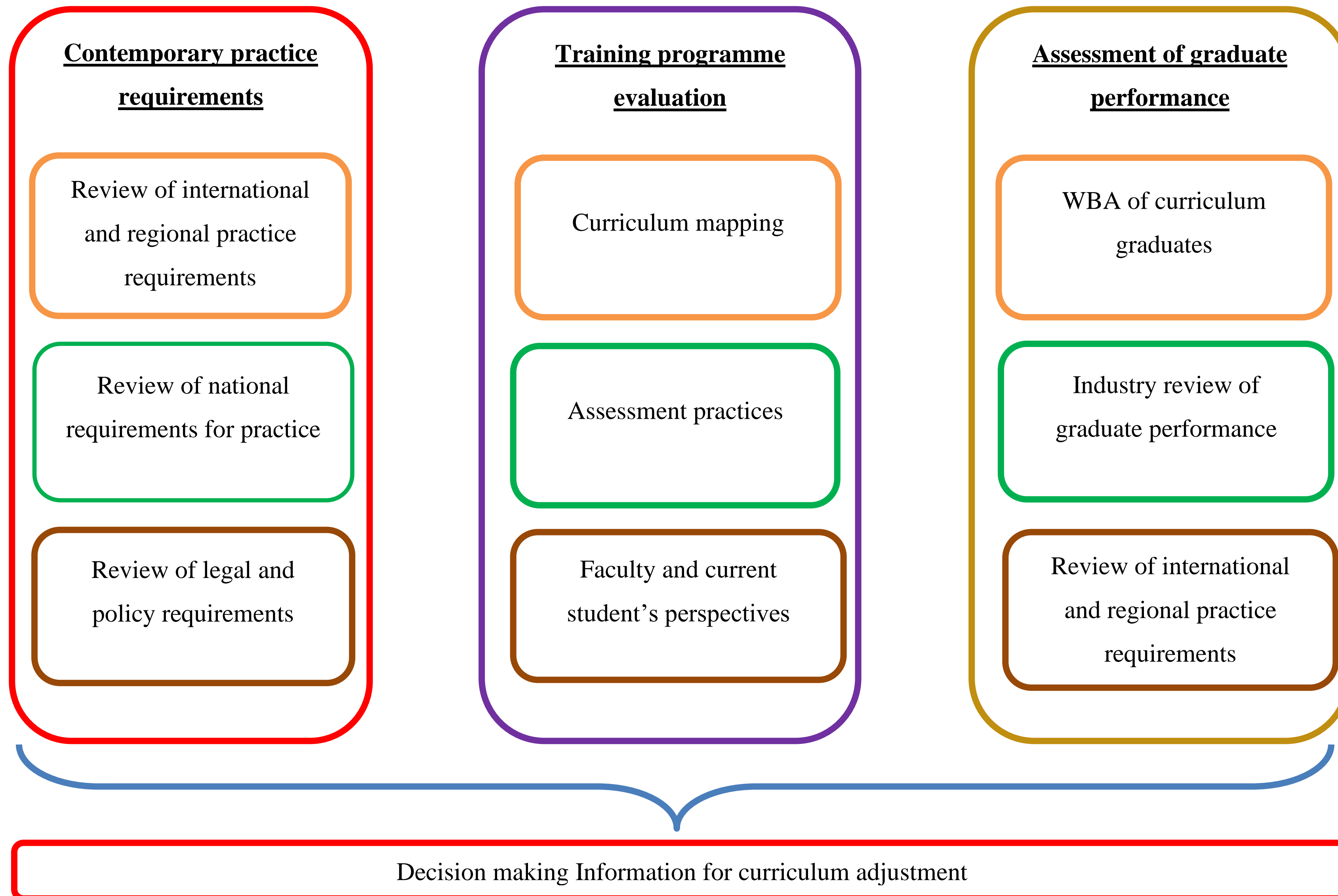

Figure 6.1: Three pillar information gathering framework for curriculum evaluation

6.4.1.1 Contemporary practice requirements

From our study we were able to establish a set of competencies required for radiographers practicing in the Zambian radiography sphere through a survey. The survey data was initially modelled on international radiography practice requirements. using this as a basis we itemised three data sources that must be engaged to establish contemporary practice requirement. These include international sources, national requirements (from experts in the field), and local legal and policy framework that guide practice.

6.4.1.2 Training programme evaluation

In this category, information can be sought from conducting a curriculum mapping process as advocated by Harden (2001a). Another source may include review of assessment practices by comparing them to stated curriculum objectives. Information collected from teaching staff and students in current training may also improve the decision-making process.

6.4.1.3 Assessment of graduate competence

This is one area that is not used adequately by the Zambia radiography curriculum review process. As demonstrated in this study, use of WBA, Clinical manager/supervisors views and indeed self-perceived competency assessment may contribute positively to the decision making process.

An integrated evaluation approach that combines data from the above named three sources can result in decisions that are evidence-based and in keeping with contemporary requirement for practice. The graduates of a training programme which as such an approach to curriculum review is likely to meet the aspirations of industry. As noted previously good curriculum review practices are only a part of the processes required to deliver effective and efficient training.

The major recommendation from this study is that the use of WBA in providing the information required in the decision-making process for making alternative judgements for curriculum change should be encouraged. In Miller's Pyramid, assessment of the "DOES" level can take many forms like 360-degree appraisals, Mini clinical examination, Long cases, Objectively Structured Clinical Examination, clinical diaries, portfolios e.t.c. (Norcini, 2003). As was the case in this current study, the assessment outcomes yield information which was used to point out deficiencies in the 2004 radiography curriculum.

6.5 Future research opportunities

This study took an exemplar approach to test the practicability of using WBA as a method of collecting data for making decisions. During the analysis of information, it was evident that several areas required additional study efforts to fully understand the value of WBA in informing curriculum development and review. Furthermore, research in radiography practice also needs further investigation. The following are suggested study area;

i. The role mentorship would play in improving the competence of already qualified radiographer
ii. The impact carefully designed CPD training would have on the skills improvement of already qualified radiographers
iii. Survey of mentorship programmes and their impact with regard to quality improvement of radiographer skills
iv. A complete curriculum mapping of the Zambian radiography programme to identify the assessment and teaching methods in current practice

6.6 Recommendations

The recommendations of the study are divided into two, those that relate to radiography practice and the others relating to curriculum developers.

6.6.1 Radiography Practice

i. The Delphi process and the FGD yielded a competence list that should be integrated in the job specification of radiographers in Zambia. The broad competence categories should include; Professional, Clinical, Interpersonal, Patient care, Technical, Administrative/ Management, Training /Education, and Research (See appendix 11 for detailed sub-competences)

ii. A mentoring programme should be developed that should ensure continued guiding of newly graduated and recruited radiographers to strengthen their clinical and technical competence

6.6.2 Curriculum developers

i. The use of the three-pillar information gathering framework for curriculum evaluation should be encouraged amongst developers. Curriculum developers must enrich their information sources required for decision making related to a new or revised curriculum.

ii. Developers of curriculum for radiography in Zambia must pay particular attention to the correct use of learning taxonomy in order to ensure that curricula are pitched at the appropriate level

6.7 Conclusion

The main aim of the study was to establish the influence WBA can have on curriculum development practices for radiographers, especially in the Zambian setting. We found

that WBA provided valuable information that was able to guide and inform the curriculum review processes.

REFERENCES

Allen, W. C. (2006). Overview and evolution of the ADDIE training system. *Advances in Developing Human Resources* 8, 430-441.

Amin, Z., Chong, Y. S. and Khoo, H.E. (2006). *Practical guide to medical student assessment*. World Scientific. New Jersey. ISBN 981-256-808-5

Andersson, B. T. (2012). *Radiographers' professional competence: Development of a context-specific instrument*. School of Health Sciences. ISBN 978-91-85835-33

Andersson, B. T., Christensson, L., Fridlund, B. and Broström, A. (2012a). Development and psychometric evaluation of the radiographers' competence scale. *Open journal of Nursing*, 2, 85-96.

Andersson, B. T., Christensson, L., Jakobsson, U., Fridlund, B. and Broström, A. (2012b). Radiographers' self-assessed level and use of competencies- a national survey. *Insights imaging*, 3, 635-645.

Anim-Sampong, S., Arthur, L., Nkansah, J. A. and Botwe, B. O. (2018). Women in radiography practice in Ghana: Motivating and demotivating factors. *Radiologic Technology*, 89, 337-343.

Archer, J. C. and Mcavoy, P. (2011). Factors that might undermine the validity of patient and multi-source feedback. *Medical Education*, 45, 886-93.

Arkün, S. and Akkoyunlu, B. (2008). A study on the development process of a multimedia learning environment according to the ADDIE model and students' opinions of the multimedia learning environment. *Interactive educational multimedia*:17, 1-19.

Biggs, J. (1999). What the student does: Teaching for enhanced learning. *Higher Education Research & Development*, 18, vol 1, 57-75.

Björkman, B., Fridell, K. and Tavakol Olofsson, P. (2017). Plausible scenarios for the radiography profession in Sweden in 2025. *Radiography*, 23, 314-320.

Bloxham, S. and Boyd, P. (2007). *Developing effective assessment in higher education: A practical guide: A practical guide*, McGraw-Hill Education, UK. ISBN 13: 9780 335 221073

Bolderston, A., Lewis, D. and Chai, M. (2010). The concept of caring: Perceptions of radiation therapists. *Radiography*, 16, 198-208.

Brealey, S., Hewitt, C., Scally, A., Hahn, S., Godfrey, C. and Thomas, N. (2009). Bivariate meta-analysis of sensitivity and specificity of radiographers' plain radiograph reporting in clinical practice. *British journal of radiology*, 82, 600-604.

Brown, A. (2004). Professionals under pressure: Contextual influences on learning and development of radiographers in England. *Learning in Health and Social Care*, 3, 213-222.

Burchell, H., Higgs, T. and Murray, S. (1999). Assessment of competence in radiography education. *Assessment & Evaluation in Higher Education*, 24, 315-326.

Bushberg, J. T. and Boone, J. M. (2011). *The essential physics of medical imaging*, Lippincott Williams & Wilkins. Philadelphia. ISBN 978-0-7817-8057-5

Campbell, S. S., Morton, D. and Grobler, A. D. (2019). Transitioning from analogue to digital imaging: Challenges of South African analogue-trained radiographers. *Radiography*, 25, 39-44.

Cascade, P. N., Kazerooni, E. A., Gross, B. H., Quint, L. E., Silver, T. M., Bowerman, R. A., Pernicano, P. G. and Gebremariam, A. (2001). Evaluation of competence in the interpretation of chest radiographs. *Academic radiology*, 8, 315-321.

Castillo, J., Caruana, C. J. and Wainwright, D. (2011). The changing concept of competence and categorisation of learning outcomes in Europe: Implications for the design of higher education radiography curricula at the European level. *Radiography*, 17, 230-234.

Clark, P. A. and Hogg, P. (2003). Reject/repeat analysis and the effect prior film viewing has on a department's reject/repeat rate. *Radiography*, 9, 127-137.

Couto, J., Mcfadden, S., Bezzina, P., Mcclure, P. and Hughes, C. (2018). An evaluation of the educational requirements to practise radiography in the European Union. *Radiography*, 24, 64-71.

Cowling, C. (2008). A global overview of the changing roles of radiographers. *Radiography*, 14, 28-32.

Cowling, C. (2013). Global review of radiography. *Radiography*, 19, 90-91.

Creswell, J.W. (2007). *Qualitative inquiry and research design: Choosing among five approaches*, SAGE, London. ISBN 1-4129-1607-0

Creswell, J.W. (2014). *Research design: Qualitative, Quantitative, and Mixed methods approaches 4th ed*, London SAGE. 978-1-4522-2610-1

Croissant, J. L. (1999) *Engendering technology: Culture, gender, and work*. 1999 International Symposium on Technology and Society-Women and Technology: Historical, Societal, and Professional Perspectives. Proceedings. Networking the World (Cat. No. 99CH37005), 1999. IEEE, 276-281.

Crossley, J. and Jolly, B. (2012). Making sense of work-based assessment: Ask the right questions, in the right way, about the right things, of the right people. *Medical Education*, 46, 28-37.

Cunningham, J. (2015). Managing clinical education through understanding key principles. *Radiologic Technology*, 86.

Dahlgren, L., Emmelin, M. and Winkvist, A. (2004). *Qualitative methodology for international public health*, UMEA Sweden, ISBN 91 7305 776-2

Downing, S. M. and Yudkowsky, R. (2009). *Assessment in health professions education*, Routledge. New York. ISBN 1135595305

Driessen, E.W., Van Tartwijk, J., Govaerts, M., Teunissen, P. and Van Der Vleuten, C. P. (2012). The use of programmatic assessment in the clinical workplace: A Maastricht case report. *Medical Teacher*, 34, 226-231.

Dunn, M. A. and Rogers, A. T. (1998). X-ray film reject analysis as a quality indicator. *Radiography*, 4, 29-31.

Du Plessis, J. and Pitcher, R. (2015) Towards task shifting? A comparison of the aaccuracy of acute trauma-radiogra reporting by medical officers and senior radiographers in an African hospital. *Pan African Medical Journal* 21:308

Eddy, A. (2008). Advanced practice for therapy radiographers – a discussion paper. *Radiography*, 14, 24-31.

Edwards, H., Vosper, M., Miller, L., Price, R., Herbland, A., Masurier, S., Cherril, R. and Smailes, E. (2009). *The effect of agenda for change on career progression of the radiographic workforce*. Society of Radiographers, London

Ehrlich, R., Ann and Daly, J. A. (2009). *Patient care in radiography with an introduction to medical imaging*. Mosby, St Louis Missouri. ISBN 978-0-323-05178-1

England, A., Geers-Van Gemeren, S., Henner, A., Kukkes, T., Pronk-Larive, D., Rainford, L. and Mcnulty, J. P. (2017). Clinical radiography education across Europe. *Radiography*, 23, S7-S15.

Epstein, R. M. (2007). Assessment in medical education. *New England journal of medicine*, 356, 387-396.

European Commission (1996). *Europe guidelines on quality criteria for diagnostic radiographic images.* EC. Luxembourg. ISBN 92-827-7284-5

Finch, C. R. and Crunkilton, J. R. (1999). *Curriculum development in vocational and technical education. Planning, content, and implementation*, ERIC. ISBN 0 205 279 023

Forbes, T. and Prime, N. J. (2000). Moving domains: Radiographers as managers in NHS. *Radiography*, 6, 101-110.

Francis, A., Hills, C., Macdonald-Wicks, L., Johnston, C., James, D., Surjan, Y. and Warren-Forward, H. (2016). Characteristics of an ideal practice educator: Perspectives from practice educators in diagnostic radiography, nuclear medicine, nutrition and dietetics, occupational therapy and physiotherapy and radiation therapy. *Radiography*, 22, 287-294.

Frye, A. W. and Hemmer, P. A. (2012). Program evaluation models and related theories: AMEE guide no. 67. *Medical Teacher*, 34, 288-299.

Gonzalo, J. D., Ahluwalia, A., Hamilton, M., Wolf, H., Wolpaw, D. R. and Thompson, B. M. (2018). Aligning education with health care transformation: Identifying a shared mental model of “new” faculty competencies for academic faculty. *Academic Medicine*, 93, 256-264.

Gottipati, S. and Shankararaman, V. (2018). Competency analytics tool: Analyzing curriculum using course competencies. *Education Information Technologies*, 23, 41-60.

Govaerts, M. and Van Der Vleuten, C. P. (2013). Validity in work-based assessment: Expanding our horizons. *Medical Education*, 47, 1164-74.

Grant, A. and Bach, S. (2009). *Communication and interpersonal skills for nurses*, SAGE. ISBN: 978 1 844 451 623

Grant, J. (2014). *Principles of curriculum design*. In: Swanwick, T. (ed.) *Understanding Medical Education: Evidence, Theory Practice*. John Wiley Sons. Malaysia. ISBN 978-1-4051-9680-2

GRZ (2009). Health Professions Act, 2009, GRZ, Lusaka.

GRZ (2017). Zambia National Health Strategic Plan 2017 – 2021. In: Health, M. O. (ed.). GRZ Lusaka:

Gustafson, K. L. and Branch, R. M. (2002). *What is instructional design*. In Trends issues in instructional design technology, 16-25.

Gweta,N. (2012) Role extension: The needs, perceptions and experiences of south African radiographers in primary health care. *The South African radiographer*. Vol 50:1pp 22-26

Hafslund, B., Clare, J., Graverholt, B. and Nortvedt, M. W. (2008). Evidence-based radiography. *Radiography*, 14, 343-348.

Hakan, K. and Seval,F. (2011). CIPP evaluation model scale: development, reliability and validity. *Procedia-Social and Behavioral Sciences* Vol 15, 592-599

Hall, A. S. and Durward, B. R. (2009). Retention of anatomy knowledge by student radiographers. *Radiography*, 15, e22-e28.

Hall, E. J. and Giaccia, A. J. (2006). *Radiobiology for the radiologist*, Lippincott Williams & Wilkins. Philadelphia. ISBN 978-1-60831-193-4

Harden, R., M (2001). AMEE guide no. 21: Curriculum mapping: A tool for transparent and authentic teaching and learning. *Medical Teacher*, 23, 123-137.

Harden, R. M. (1986). Ten questions to ask when planning a course or curriculum. *Medical Education*, 20, 356-365.

Hardy, M. and Persaud, A. (2001). The challenge of governance: Achieving quality in diagnostic imaging. *Radiography*, 7, 159-163.

Hart, C. (2018). *Doing a literature review: Releasing the research imagination*, SAGE London. ISBN 152 642 314 6

Hayes, K. and Easter, E. (2012). Work-place based assessments (WBAs): An update. *Obstetrics, Gynaecology & Reproductive Medicine*, 22, 205-207.

Hays, R. (2008). Assessment in medical education: Roles for clinical teachers. *The clinical teacher*, 5, 23-27.

Hellman, E. and Lindgren, M. (2014). Radiographers' perceptions of patients care needs during a Computed Tomography examination. *Journal of Radiology Nursing*, 33, 206-213.

Hill, C., Corbett, C. and St Rose, A. (2010). Why so few? Women in science, technology, engineering, and mathematics, ERIC. Washington. ISBN 978-1-879922-40-2

Hoorens, V. (1993) self-enhancement and superiority biases in social comparison. *European review of social psychology*. Vol 4 pp113-139

HPCZ (2014). Professional code of ethics and discipline: Fitness to practice. Lusaka: HPCZ.

Hsu, C.C. and Sandford, B.A. (2007). The delphi technique: Making sense of consensus. *J Practical assessment, research evaluation*, 12, 1-8.

IAEA (2010). *Comprehensive clinical audits of diagnostic radiology practices: A tool for quality improvement*, IAEA. Vienna. ISBN 9 201 120 095

ISRRT. (2019). *Professional practice - image interpretation* [Online]. Available: http://maketes.eu/isrrt/image-interpretation [Accessed on 16/05/2019].

Istomina, N., Suominen, T., Razbadauskas, A., Martinkėnas, A., Meretoja, R. and Leino-Kilpi, H. (2011). Competence of nurses and factors associated with it. *Medicina (Kaunas);*47(4)

Jackson, C. (2007). Assessment of clinical competence in therapeutic radiography: A study of skills, characteristics and indicators for future career development. *Radiography*, 13, 147-158.

Jang, H. (2016). Identifying 21st century stem competencies using workplace data. *J Journal of Science Education Technology*, 25, 284-301.

Joiner, M. C. and Van Der Kogel, A. (2016). *Basic clinical radiobiology*, CRC press. Great Britain. ISBN 978 0 340 929 667

Jonbekova, D. (2015). University graduates' skills mismatches in central Asia: Employers' perspectives from post-soviet Tajikistan. *J European Education*, 47, 169-184.

Jones, H. and Manning, D. (2008). A survey to assess audit mechanisms practised by skeletal reporting radiographers. *Radiography*, 14, 201-205.

Jorge, J. and Scheller, L. (2014). Radiographers' communicative activity: A case study. *Journal of Clinical Radiography and Radiotherapy*, 9. issue 2, 10-18

Judson, E. and Nightingale, J. (2009). An evaluation of radiographer performed and interpreted barium swallows and meals. *Clinical radiology*, 64, 807-814.

Kajander-Unkuri, S. (2015). *Nurse competence of graduating nursing students*. University of Turku, Finland ISBN 978-951-29-6002-6

Katowa-Mukwato, P. and Banda, S. (2016). Self-perceived versus objectively measured competence in performing clinical practical procedures by final year medical students. *International journal of medical education*, 7, 122.

Kaufman, R. and Keller, J. M. (1994). Levels of evaluation: Beyond kirkpatrick. *Human Resource Development Quarterly*, 5, 371-380.

Kawooya, M.C.(2012) Training for rural radiology and imaging in sub-saharan Africa:Addressing the mismatch between services and population. Journal of clinical imaging science vol 2; pp 37

Kekana, R.M., Swindon, L.D., and Mathobisa, J.M. (2015) A survey of South African radiographers' and radiologists' opinions on role extension for radiographers. *African Journal for Physical Health Education, recreation and dance* Vol. 21 issue 4.1 pp 1114-1125

Kelley, J. M., Kraft-Todd, G., Schapira, L., Kossowsky, J. and Riess, H. (2014). The influence of the patient-clinician relationship on healthcare outcomes: A systematic review and meta-analysis of randomized controlled trials. *PloS one*, 9, e94207.

Kilgour, A. (2011). Assessment of competency in radiography students—a new approach. *Radiographer,* 58, 32-37.

Knight, A. W. (2018). How clinical instructor behaviour affects student clinical engagement from a motivational perspective. *Journal of nuclear medicine technology*, 46, 99-106.

Kreitner, R. (2009). *Management*, Houghton Mifflin Harcourt. Canada ISBN-13: 978-0-547-14848-9

Kubik-Huch, R., Klaghofer, R., Römpler, M., Weber, A. and Buddeberg-Fischer, B.. (2010). Workplace experience of radiographers: Impact of structural and interpersonal interventions. *J. Euro. Raddio* 20, 377-384.

Larsson, W., Aspelin, P. and Lundberg, N. (2013). Learning strategies in the planning and evaluation phase of image production. *Radiography*, 19, 347-352.

Lau, S.-L., Mak, A. S.-H., Lam, W.-T., Chau, C.-K. and Lau, K.-Y. (2004). Reject analysis: A comparison of conventional film–screen radiography and computed radiography with PACS. *Radiography*, 10, 183-187.

Law, R., Titcomb, D., Carter, H., Longstaff, A., Slack, N. and Dixon, A. (2008). Evaluation of a radiographer-provided barium enema service. *Colorectal Disease*, 10, 394-396.

Levin, T. (2010). Curriculum evaluation. In: PETERSON, P., BAKER, E. & MCGAW, B. (eds.) International encyclopedia of education (third edition). Oxford: Elsevier.

Lewis, S. J., Eccles, G. R., Mackay, S. J. and Robinson, J. (2017). Emotional intelligence throughout the lifecycle of Australian radiographers. *Radiologic technology* 89, 12-19.

Lima, S., Newall, F., Kinney, S., Jordan, H. L. and Hamilton, B. (2014). How competent are they? Graduate nurses self-assessment of competence at the start of their careers. *Colegian*, 21, 353-358.

Ling, Y., Swanson, D. B., Holtzman, K. and Bucak, S. D. (2008). Retention of basic science information by senior medical students. *Academic Medicine*, 83, S82-S85.

Mackay, S., Anderson, A. and Hogg, P. (2008). Preparedness for clinical practice–perceptions of graduates and their work supervisors. *Radiography*, 14, 226-232.

Mackay, S., Hogg, P., Cooke, G., Baker, R. and Dawkes, T. (2012). A UK-wide analysis of trait emotional intelligence within the radiography profession. *Radiography*, 18, 166-171.

Malamateniou, C. (2009). Radiography and research: A United Kingdom perspective. *European Journal of Radiography*, 1, 2-6.

Manogue, M., Kelly, M., Bartakova Masaryk, S., Brown, G., Catalanotto, F., Choo-Soo, T., Delap, E., Godoroja, P., Morio, I. and Rotgans, J. (2002). 2.1 evolving methods of assessment. J European *Journal of Dental Education*, 6, 53-66.

Marshall, G. and Harris, P. (2000). A study of the role of an Objective Structured Clinical Examination (OSCE) in assessing clinical competence in third year student radiographers. *Radiography*, 6, 117-122.

Marzo-Navarro, M., Pedraja-Iglesias, M. and Rivera-Torres, P. (2009). Curricular profile of university graduates versus business demands: Is there a fit or mismatch in Spain? *Education +Training*, 51, 56-69.

Massie, J. and Ali, J. M. (2016). Workplace-based assessment: A review of user perceptions and strategies to address the identified shortcomings. *Advances in health sciences education*, 21, 455-473.

Mathison, S. (2010). *The purpose of educational evaluation*. In: PETERSON, P., BAKER, E. & MCGAW, B. (eds.) International encyclopedia of education (third edition). Oxford: Elsevier.

Matlay, H., Mandilas, A., Kourtidis, D. and Petasakis, Y. (2014). Accounting curriculum and market needs. *Education+ Training*. 56 8/9

Mc Inerney, J. and Baird, M. (2016). Developing critical practitioners: A review of teaching methods in the bachelor of radiography and medical imaging. *J Radiography*, 22, e40-e53.

Mckim, C. A. (2017). The value of mixed methods research: A mixed methods study. *J Journal of Mixed Methods Research*, 11, 202-222.

Mckimm, J. (2010). Current trends in undergraduate medical education: Program and curriculum design. *Samoa Medical Journal*, 1, 40-48.

Mckimm, J. and Swanwick, T. (2013). *Clinical teaching made easy. A practical guide to teaching and learning in clinical settings*. , Quay Books

Mcneil, R. C. (2011). A program evaluation model: Using bloom's taxonomy to identify outcome indicators in outcomes-based program evaluations. *Journal of adult education*, 40, 24-29.

Mehay, R. and Burns, R. (2009). Miller's pyramid of clinical competence (1990). J Abgerufen unter http://www. essentialgptrainingbook. com.

Merritt, B. K., Blake, A. I., Mcintyre, A. H. and Packer, T. (2012). Curriculum evaluation: Linking curriculum objectives to essential competencies. *Canadian Journal of Occupational Therapy*, 79, 175-180.

Miller, G. E. (1990). The assessment of clinical skills/competence/performance. *Academic medicine*, 65, S63-7.

Moonen-Van Loon, J., Overeem, K., Donkers, H., Van Der Vleuten, C. and Driessen, E. (2013). Composite reliability of a workplace-based assessment toolbox for postgraduate medical education. *Advances in health sciences education*, 18, 1087-1102.

Mount, J. (2016). Reject analysis: A comparison of radiographer and radiologist perceptions of image quality. *Radiography*, 22, 112-117.

Mraity, H., England, A. and Hogg, P. (2014). Developing and validating a psychometric scale for image quality assessment. *Radiography*, 20, 306-311.

MSTVT (1996). *Technical Education, Vocational and Entrepreneurship Training (TEVET) policy.* In: TEVETA (ed.). LUSAKA: GRZ.

Munsanje, F. (2014). *Frontline radiographic human capital development: A case of Zambia and way forward.*

Murphy, F. J. (2006). The paradox of imaging technology: A review of the literature. *Radiography*, 12, 169-174.

Mwanza, P. (2015). The state of girl-child's education in zambia: The case of Chongwe district. *Journal of International Cooperation in Education*, 17, 95-110.

Nair, B. R., Hensley, M. J., Parvathy, M. S., Lloyd, D. M., Murphy, B., Ingham, K., Wein, J. M. and Symonds, I. M. (2012). A systematic approach to workplace-based assessment for international medical graduates. *Medical Journal of Australia*, 196, 399-402.

Nair, B. R., Moonen-Van Loon, J. M., Parvathy, M., Jolly, B. C. and Van Der Vleuten, C. P. (2017). Composite reliability of workplace-based assessment of international medical graduates. *Medical Journal of Australia*, 207, 453-453.

Neuman, W. L. (1997). Social research methods: Qualitative and quantitative approaches. 3rd ed, Allyn and Bacon, Boston. ISBN 0-205-26561-8

Ng, C. K., White, P. and Mckay, J. C. (2008). Establishing a method to support academic and professional competence throughout an undergraduate radiography programme. *Radiography*, 14, 255-264.

Ni, Y. J. (2010). Educational evaluation: Concepts, practice, and future directions. In: PETERSON, P., BAKER, E. & MCGAW, B. (eds.) International encyclopedia of education (third edition). Oxford: Elsevier. ISBN 978-0-08-044894-7

Nightingale, J. (2016). Establishing a radiography research culture – are we making progress? *Radiography*, 22, 265-266.

Norcini, J. (2005). Current perspectives in assessment: The assessment of performance at work. *J Medical education*, 39, 880-889.

Norcini, J., Anderson, B., Bollela, V., Burch, V., Costa, M. J., Duvivier, R., Galbraith, R., Hays, R., Kent, A., Perrott, V. and Roberts, T. (2011). Criteria for good assessment: Consensus statement and recommendations from the ottawa 2010 conference. *Medical Teacher*, 33, 206-214.

Norcini, J. J. (2003). Work based assessment. *British Medical Journal*, 326, 753-755.

Norcini, J. J. and Banda, S. S. (2011). Increasing the quality and capacity of education: The challenge for the 21st century. *International Journal of Medical Education*, 45, 81-86.

Ocholla, D. N. (2001). Curriculum response to a changing national and international information environment: Theoretical and methodological paradigms on review and revision 1. *Education for information*, 19, 143-167.

Oliver, B., Ferns, S., Whelan, B. and Lilly, L. (2010). Mapping the curriculum for quality enhancement: Refining a tool and processes for the purpose of curriculum renewal. *J Proceedings of AuQF . Quality in Uncertain Times.*, 80-88.

Overeem, K., Faber, M. J., Arah, O. A., Elwyn, G., Lombarts, K. M., Wollersheim, H. C. and Grol, R. P. (2007). Doctor performance assessment in daily practise: Does it help doctors or not? A systematic review. *Medical Education*, 41, 1039-49.

Owens, J. (2006). *Program evaluation forms and approaches*. 3rd ed.: Allen & Unwin.

Paul Griffin, R. (2010). Means and ends: Effective training evaluation. *Industrial and Commercial Training*, 42, 220-225.

Payne, K. (1998). A pilot study of gender inequalities related to radiography education and career progression. *Radiography*, 4, 279-287.

Peng, L., Zhang, S. and Gu, J. (2016). Evaluating the competency mismatch between master of engineering graduates and industry needs in china. *Studies in Higher Education*, 41, 445-461.

Périard, M. and Chaloner, P. (1996). Diagnostic x-ray imaging quality assurance: An overview. *J Canadian Journal of Medical Radiation Technology*, 27, 171-177.

Perram, A., Hills, C., Johnston, C., Macdonald-Wicks, L., Surjan, Y., James, D. and Warren-Forward, H. (2016). Characteristics of an ideal practice educator: Perspectives from undergraduate students in diagnostic radiography, nuclear medicine, nutrition and dietetics, occupational therapy, physiotherapy and radiation therapy. *Radiography*, 22, 295-305.

Piper, K., Cox, S., Paterson, A., Thomas, A., Thomas, N., Jeyagopal, N. and Woznitza, N. (2014). Chest reporting by radiographers: Findings of an accredited postgraduate programme. *Radiography*, 20, 94-99.

Plaza, C. M., Draugalis, J. R., Slack, M. K., Skrepnek, G. H. and Sauer, K. A. (2007). Curriculum mapping in program assessment and evaluation. *American Journal of Pharmaceutical Education*, 71, 20.

Pratt, S. and Adams, C. (2003). How to create a degree course in radiography: A recipe. *Radiography*, 9, 317-322.

Price, R. (2009). Diploma to degree 1976 to 1993. *Radiography*, 15, 67-71.

Price, R. C. and Edwards, H. M. (2008). Harnessing competence and confidence: Dimensions in education and development for advanced and consultant practice. *Radiography*, 14, e65-e70.

Prideaux, D. (2003a). ABC of learning and teaching in medicine. Curriculum design. *British Medical Journal*. 326, 268-70.

Prideaux, D. (2003b). Curriculum design. British Medical Journal, 326, 268-270.

Redmond, R. A. and Curtis, E. A. (2009). Focus groups: Principles and process. *J Nurse researcher,* 16. 58-69

Reeves, P. J. (2008). Research in medical imaging and the role of the consultant radiographer: A discussion. *Radiography*, 14, 61-64.

Reeves, P. J. and Decker, S. (2012). Diagnostic radiography: A study in distancing. *Radiography*, 18, 78-83.

Reid, J. (2005). ARRT gender comparison. *Radiologic technology* 77, 143-146.

Reid, K. and Edwards, H. (2011). Evaluating the role of the diagnostic research radiographer. *Radiography*, 17, 207-211.

Salas, E., Almeida, S. A., Salisbury, M., King, H., Lazzara, E. H., Lyons, R., Wilson, K. A., Almeida, P. A. and Mcquillan, R. (2009). What are the critical success factors for team training in health care? The Joint Commission *Journal on Quality and Patient Safety*, 35, 398-405.

Sathekge, M. M. (2017). Work-based assessment: A critical element of specialist medical training. *South African Medical Journal*, 107, 728-728.

Schmidt, L. F. (2006). Gender roles, socialization and hierarchy in an allied health profession: Radiography students constructs of self and the profession.

Singer, A. H. (2016). The potential of workplace-based assessment of international medical graduates. *Medical Journal of Australia*, 205, 209-210.

Skulmoski, G. J., Hartman, F. T. and Krahn, J. (2007). The Delphi method for graduate research *Journal of Information Technology Education: Research*.. 6, 1-21.

Sloane, C. and Miller, P. K. (2017). Informing radiography curriculum development: The views of UK radiology service managers concerning the 'fitness for purpose' of recent diagnostic radiography graduates. *Radiography,* 23, S16-S22.

Snaith, B., Hardy, M. and Lewis, E. F. (2015). Radiographer reporting in the UK: A longitudinal analysis. *Radiography*, 21, 119-123.

Sonnex, E., Tasker, A. and Coulden, R. (2001). The role of preliminary interpretation of chest radiographs by radiographers in the management of acute medical problems within a cardiothoracic centre. *British journal of radiology*, 74, 230-233.

SOR (2007). Development framework for clinical imaging and oncology. Society of Radiographers UK

SOR (2013). Code of professional conduct. Society of Radiographers UK

SOR.(2019a). Patient information [Online]. Society of Radiographers UK

SOR (2019b). What is radiography? Who are radiographers? Society of Radiographers UK London.

Southgate, L., Cox, J., David, T., Hatch, D., Howes, A., Johnson, N., Jolly, B., Macdonald, E., Mcavoy, P., Mccrorie, P. and Turner, J. (2001). The assessment of poorly performing doctors: The development of the assessment programmes for the general medical council's performance procedures. *Medical Education*, 35 Suppl 1, 2-8.

Stami, T., Ritin, F. and Dominique, P. (2018). Demographic predictors of emotional intelligence among radiation therapists. *Journal of medical radiation sciences* 65, 114-122.

Stein-Parbury, J. (2013). *Patient and person: Interpersonal skills in nursing*, Elsevier Health Sciences.

Strudwick, R. M. and Day, J. (2014). Inter-professional working in diagnostic radiography. *Radiography*, 20, 235-240.

Sullivan, P. B., Gregg, N., Adams, E., Rodgers, C. and Hull, J. (2013). How much of the paediatric core curriculum do medical students remember? *Advances in Health Sciences Education*, 18, 365-373.

Talab, A. H. D., Mahmodi, F., Aghaei, H., Jodaki, L. and Ganji, D. (2016). Evaluation the effect of individual and demographic factors on awareness, attitude and performance of radiographers regarding principles of radiation protection. *Al Ameen J Med Sci*, 9, 90-5.

TEVETA 2005. TEVET ACT. GRZ

TEVETA (2010). *Standards for curriculum development and review*. In: TEVETA (ed.). Lusaka: TEVETA.

Thompson, A. M. and Henwood, S. M. (2016). From the clinical to the managerial domain: The lived experience of role transition from radiographer to radiology manager in South-east Queensland. *Journal of medical radiation sciences*, 63, 89-95.

Uchiyama, K. P. and Radin, J. L. (2009). Curriculum mapping in higher education: A vehicle for collaboration. *Innovative Higher Education*, 33, 271-280.

Van De Venter, R. and Ten Ham-Baloyi, W. (2019). Image interpretation by radiographers in south africa: A systematic review. *Radiography*, 25, 178-185.

Van Der Vleuten, C., Schuwirth, L., Scheele, F., Driessen, E. and Hodges, B. (2010). The assessment of professional competence: Building blocks for theory development. Best practice & research *Clinical obstetrics & gynaecology*, 24, 703-719.

Van Der Vleuten, C. P., Schuwirth, L., Driessen, E., Dijkstra, J., Tigelaar, D., Baartman, L. and Van Tartwijk, J. (2012). A model for programmatic assessment fit for purpose. *Medical Teacher*, 34, 205-214.

Vanckavičienė, A., Macijauskienė, J., Blaževičienė, A., Basevičius, A. and Andersson, B. T. (2017). Assessment of radiographers' competences from the perspectives of radiographers and radiologists: A cross-sectional survey in lithuania. *BMC medical education*, 17, 25.

Vikestad, K. G., Hafskjold, L., Kjelle, E., Sebuødegård, S. and Hofvind, S. (2017). Radiographers' opinions on radiography research in Norway – a national survey. *Radiography*, 23, 135-140.

Walvoord, B. E. (2010). *Assessment clear and simple. A practical guide for institutions, departments, and general education second edition*, San Francisco, Jossey-Bass.

Wangensteen, S., Johansson, I. S., Björkström, M. E. and Nordström, G. (2012). Newly graduated nurses' perception of competence and possible predictors: A cross-sectional survey. *Journal of Professional Nursing* 28, 170-181.

WFME (2015). *Basic medical education WFME global standards for quality improvement*. Ferney-Voltaire: WORLD FEDERATION FOR MEDICAL EDUCATION.

White, P. and Mckay, J. (2002). Guidelines and legal requirements which inform role expansion in radiography. *Radiography,* 8, 71-78.

Willett, T. G. (2008). Current status of curriculum mapping in Canada and the UK. *Medical education*, 42, 786-793.

Williams, I. (2006). Professional role extension for radiographers: Opinion article. *J South African Radiographer*, 44, 14-17.

Williams, P. L. and Berry, J. E. (1999). What is competence? A new model for diagnostic radiographers: Part 1. *Radiography*, 5, 221-235.

Williams, I (2009) Reporting trauma and emergency plain film radiographs: Radiologists' support for role extension of south African radiographers. *The South African radiographer.* Vol 47:1 pp15-18

Wolff, A. C., Pesut, B. and Regan, S. (2010). New graduate nurse practice readiness: Perspectives on the context shaping our understanding and expectations. *Nurse Education Today*, 30, 187-191.

Woods, A., Luke, A. and Weir, K. (2010). *Curriculum and syllabus design*. In: PETERSON, P., BAKER, E. & MCGAW, B. (eds.) International encyclopedia of education (third edition). Oxford: Elsevier.

Woznitza, N., Piper, K., Burke, S. and Bothamley, G. (2018). Chest x-ray interpretation by radiographers is not inferior to radiologists: A multireader, multicase comparison using jafroc (jack-knife alternative free-response receiver operating characteristics) analysis. *Academic Radiology*, 25, 1556-1563.

Woznitza, N., Piper, K., Burke, S., Patel, K., Amin, S., Grayson, K. and Bothamley, G. (2014). Adult chest radiograph reporting by radiographers: Preliminary data from an in-house audit programme. *Radiography*, 20, 223-229.

Zinovieff, M. A. and Rotem, A. (2008). *Review and analysis of training impact evaluation methods, and proposed measures to support a United Nations system fellowships evaluation framework*. Geneva: WHO's Department of Human Resources for Health.

APPENDICES

APPENDIX 1 DELPHI TECHNIQUE TOOL

(Preliminary questionnaire based on Williams and Berry 1999)

Questionnaire 1

Whilst completing this questionnaire, please consider that the aim of the study is to draw consensus on the Job requirements for a radiographer working at 1st, 2nd, and 3rd Level hospital in Zambia.

Section A: Demographic data

1. Please state your job title (specify grade where appropriate)
2. What town are you based in?
3. Number of years of experience

Section B: Core role description

"The primary role of a radiographer is to produce high-quality diagnostic images with due consideration of the needs of the patient."

1. Identify (circle number) your level of agreement with the above statement. With '1' being disagreed strongly and '10' being strongly agreeing
   1 2 3 4 5 6 7 8 9 10
2. Provide reasons for your level of agreement

____

____

____

____

A radiographer would undertake a number of other roles and responsibilities, some of which would affect their primary role directly, others indirectly. These could be grouped into the following categories:

- Professional
- Clinical
- Interpersonal
- Patient care

- Technical
- Administrative
- Theoretical

3a Do you consider that this list is complete? Yes/No

3b. List any category which you do not think is appropriate/relevant.

___

___

___

4c. Please add any additional categories which you think should be included.

___

___

___

4d. In each category, please list the roles and responsibilities a radiographer will undertake. If you have suggested additional headings, please incorporate them. Continue on a separate sheet if necessary.

___

___

___

___

___

NOTE: There may be an overlap between groups for some items. In these cases, place the individual roles and responsibilities under the heading that you consider to be the most appropriate with any other possible group in brackets .e.g. Technical- Recognise an appropriate standard of image quality (or clinical)

- Professional
- Clinical
- Interpersonal
- Theoretical
- Patient care
- Technical
- Administrative

- Other (please specify)

3. This project is also attempting to consider the future role of radiographers. With this in mind, please give three examples of changes that you foresee, both in the provision of health care and in society which, in your opinion will have a great impact on the role of the radiographer over the next few years. Please list both the change and the possible impact.

____

____

____

____

____

____

____

____

____

____

____

Thank you for your help in completing this questionnaire.

APPENDIX 2 SECOND CIRCULATION QUESTIONNAIRE

PARTICIPANTS INFORMATION SHEET, CONSENT & QUESTIONNAIRE

School of Medicine
Department of Medical Education Development

CONSENSUS BUILDING - SECOND DATA COLLECTION PHASE.

PARTICIPANT INFORMATION SHEET

We would like to thank you for participating in the study "Role of Workplace-Based Assessment of Radiographers in Informing Curriculum Development Practices: A Plain X-ray Technical Sufficiency Exemplar using 2010-2015 Post-Registration Radiographers". Following the first round of data collection using the Delphi technique approach in which you participated, data collected were analysed and summarized. In order to build consensus, a circulation of the findings is being made.

You are being invited to review the summarized findings and to comment. You are free to agree or disagree with the summarised views.

PARTICIPANTS' RIGHTS

I will state that participating in this study will be completely voluntary. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving reasons. This will not affect you in any way. You have the right to ask that any data you have contributed to that point be withdrawn/destroyed. You will still be respected for your contribution without any penalty. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study session begins.

WHAT WILL HAPPEN & TIME COMMITMENT

This study is divided into four phases. Data collection at this point is for phase 1 of the study

Phase 1:

The objective of the first phase will be to build consensus on contemporary job requirements of a radiographer in the Zambian healthcare setting. A qualitative approach using a Delphi technique will be used. If you participate in this phase you will be required to complete a questionnaire. You will be sent compiled responses and your option sought again until consensus is achieved.

CONFIDENTIALITY/ANONYMITY

Anonymity and confidentiality will be maintained and ensured throughout the whole process. All the information which is collected about you during the course of the research will be kept confidential. Your name will not be on the tape or transcript and all recordings

and transcriptions will be number coded to ensure confidentiality. The data will be collected by the researcher and will be accessible by the researcher only.

BENEFITS AND RISK

There will be no direct benefit for you. However, the results from the study may inform curriculum development policy which will benefit those in training. There is no risk posed to you as a participant.

FURTHER INFORMATION

Should you require further information please do not hesitate to get in touch with me or my supervisor using the details below.

Student

James M. Sichone
Email: jmaimbos@yahoo.com
Mobile: +260979548784
P.O. Box 51337
Cancer Diseases Hospital
Lusaka

Supervisor
Professor Sekelani S. Banda
National Training Coordinator
Ministry of Health
Mobile:+260966758833
Email: ssbanda2007@gmail.com

Queries may also be directed to the Chairperson of the Research Ethics Committee:
Chairperson
The University Of Zambia
Biomedical Research Ethics Committee
PO Box 50110 Ridgeway Campus Lusaka,
Zambia,
Telephone: 256067,
E-mail: unzarec@zamtel.zm

SECOND CIRCULATION (DELPHI TECHNIQUE)

Questionnaire

Following the initial survey that was completed, this recirculation aims at obtaining further clarification and consensus on the job requirements for a radiographer working at 1st, 2nd, and 3rd Level hospital in Zambia.

Section A: Core role description

First description

"The primary role of a radiographer is to produce high-quality diagnostic images with due consideration of the needs of the patient."

Refined description

''The primary role of radiographers is to assess patients and their clinical requirements in order to apply the appropriate radiographic techniques; pursuant to producing Images of diagnostic value, furthermore, to undertake additional roles that enhance radiography service delivery subject to appropriate training''

4. Compare the first and refined description of the role of a radiographer

a) Identify (circle number) your level of agreement with the refined description. With '1' being disagree strongly and '10' being strongly agreeing

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

b) Provide reasons for your level of agreement

____

____

____

____

____A radiographer would undertake a number of other roles and responsibilities, some of which would affect their primary role directly, others indirectly. These could be grouped into the following categories:

Initial categories	**Refined categories**
Professional	Professional
Clinical	Clinical
Interpersonal	Interpersonal
Patient care	Patient care

Technical	Technical
Administrative	Administrative/Management
Theoretical	Theoretical
	Training/Education
	Research

a) Identify (circle number) your level of agreement with the refined categorization. With '1' being disagree strongly and '10' being strongly agreeing
   1, 2, 3, 4, 5, 6, 7, 8, 9, 10

b) Provide reasons for your level of agreement

___

___

___

Based on the initial survey the following categories were identified with their associated roles and responsibilities.

Category	Roles and responsibilities
Professional	Technical competence
	Promotion of radiography profession
	Adherence to quality standards
	Affiliation to professional body
	Appropriately qualified
	CPD & Career development
	Observe code of ethics
	Observe code of conduct
	Adherence to QA and Quality improvement
	Compliance with regulation
	Multidisciplinary approach to care
	Conduct research and Development of protocols
	Adhere to radiation protection practices
Clinical	Perform radiographic examinations in order to produce images of diagnostic value
	Undertake film reporting

	Provide Innovation to the radiographic diagnostic process
	Work multidisciplinary manner in order to ensure best practice
	Practice high level of infection prevention
	Operate equipment in a safe and efficient manner
	Provide appropriate patient care
	Assess and evaluate patient prior to undertaking procedures
	Practice according to standard operating procedures
	Ensure adherence to radiation protection measures
Interpersonal	Multidisciplinary approach
	Practice Emotional intelligence
	Effective Communication with patients and staff
	Conflict management
	Good listener
	Learning mentality
	Respect others
	Team player
	Valuing cultural diversity
Patient care	Provide appropriate care according to need
	Ensure holistic care approach is taken
	Information provision & consent
	Patient assessment
	Patient privacy and confidentiality
	Patient comfort, safety and security
	Provision of efficient service
	Psychological care
	Radiation protection
	Infection prevention
Technical	Part of the care and maintenance programme
	Implement equipment QA programme
	Implement image quality management

	Participate in clinical Audit activities
	Technical support (mentorship)
	Technical support (policy and procurement)
	Technical competence to understand and operate high technological equipment
	Ensure patient safety and security
Administration and management	Budget and planning
	Leadership and directing of radiography services
	Resource mobilization and management
	Stock and inventory management
	Programming, scheduling and workflow management
	Departmental organization and coordination
	human resource management (capacity building, planning, appraisal)
	Data and record management
	QA programme implementation
	Equipment management and planning
Theoretical	Equip with scientific knowledge basis required for practice
	Engage in CPD and research
	Training and supervision of staff and students
Training and education	Supervision and training of students on clinical rotation
	Engaging in CPD activities (seminars, workshop etc)
	Patient and care giver education
Research	Support research activities in radiography
	Undertake research
	Publications

5. If any of the roles and responsibilities are misplaced or should not appear please indicate below

Category	Roles and responsibilities

6. If any role/s have been omitted in any category please indicate below

Category	Roles and responsibilities

7. Future roles that were listed from the initial survey include;
   i) Specialist practice
   ii) Film reporting
   iii) Equipment maintenance
   iv) Disease survey and monitoring
   v) Independent research
   vi) Performance of special studies independent of medical officers
   vii) Phlebotomy
   viii) Management of contrast side effects
   ix) Forensic radiography practice
   x) Veterinary radiography
   xi) PACs & RIS management
8. List addition future roles if the above list is not conclusive

----

Thank you for your help in completing this questionnaire.

APPENDIX 3: FOCUS GROUP DISCUSSION INTERVIEW GUIDE

The focused group interview guide

FGD Number………………………………

Date of FDG ……………./…../……………

MODERATOR’S GUIDE

- Following your analysis of proposed job requirement, what are your perceptions with regard to job requirements developed?
- How would you rate your own performances against these requirements (State reasons for your answer)?
- How would you rate the performance of radiographers you work with regard to the job requirements (State reasons for your answer)?
- In your opinion does the curriculum meet the requirements for training (Give reasons).

APPENDIX 4: INITIAL SELF-PERCEPTION QUESTIONNAIRE

Part 1

Section A: Demographic data

1) Name of Hospital: ____
2) Name of town and province: ________________________________
3) Sex: ____
4) Qualification____
5) Year of graduation____

Section B: Clinical experience

1) Modalities used since qualification

Modality	Yes	No	No of years
Plain film imaging			
Fluoroscopy			
Computed Radiography			
Digital radiography			

2) Film processing

Method	Yes	No	No of years
Automatic film processing			
Manual film processing			
Digital film processing			

3) Plain film

Examinations	**Frequency**				
	1	**2**	**3**	**4**	**5**
Chest					
Abdomen					
Pelvis					
Spine					
Skull					
Upper limb					
Lower limb					

Key (Per week)

1= **<5**, 2= **>5<10**, 3= **>10>15**, 4=>15<20, 5= >20

Part 2 Self-assessment

No	Competence	Rating					Total
		1	2	3	4	5	
1	Your ability to identify relevant anatomy coverage						
2	Your ability to accurately evaluate patient positioning						
3	Your ability to accurately evaluate film exposure						
4	Your ability to accurately evaluate film contrast						
5	Your ability to accurately evaluate image Sharpness						
7	Your ability to accurately evaluate image identification requirement						
8	Your ability to accurately evaluate radiation protection measures						
					Total score		
					Percentage score		

Key

1. Excellent
2. Very good
3. Good
4. Moderate
5. Poor

Apart from the competence list provide above include other competence necessary for a radiographer in contemporary practice.

____

Part 3

List the factors you should consider to be essential to look out for in the assessment of a chest radiograph for quality

1) ____
2) ____
3) ____
4) ____
5) ____
6) ____
7) ____
8) ____

APPENDIX 5: FINAL SELF-PERCEPTION QUESTIONNAIRE

Part 1

Section A: Demographic data

6) Name of Hospital: ____

7) Name of town and province: ________________________________

8) Sex: ____

9) Qualification____

10) Year of graduation_______________________________________

Section B: Clinical experience

4) Modalities used since qualification

Modality	Yes	No	No of years
Plain film imaging			
Fluoroscopy			
Computed Radiography			
Digital radiography			

5) Film processing

Method	Yes	No	No of years
Automatic film processing			
Manual film processing			
Digital film processing			

6) Plain film

Examinations	Frequency				
	1	**2**	**3**	**4**	**5**
Chest					
Abdomen					
Pelvis					
Spine					
Skull					
Upper limb					
Lower limb					

Key (Per week)

1= **<5**, 2= **>5<10**, 3= **>10>15**, 4=>15<20, 5= >20

Part 2 Self-assessment

No	Competence	Rating					Total
		1	2	3	4	5	
1	Your ability to identify relevant anatomy coverage						
2	Your ability to accurately evaluate patient positioning						
3	Your ability to accurately evaluate film exposure						
4	Your ability to accurately evaluate film contrast						
5	Your ability to accurately evaluate image Sharpness						
7	Your ability to accurately evaluate image identification requirement						
8	Your ability to accurately evaluate radiation protection measures						
					Total score		
					Percentage score		

Key

6. Excellent
7. Very good
8. Good
9. Moderate
10. Poor

Apart from the competence list provide above include other competence necessary for a radiographer in contemporary practice.

____

Part 3

List the factors you should consider to be essential to look out for in the assessment of a chest radiograph for quality

1) ____
2) ____
3) ____
4) ____
5) ____
6) ____
7) ____
8) ____

APPENDIX 6: WORK BASED ASSESSMENT FORM

Technical Evaluation of Chest X-Rays

Data Collection Tool Serial number: ________________________

1. Name of Hospital: ______________________________________
2. Name of town and province: ____________________________
3. Sex: ____
4. Qualification:____
5. Year of graduation:_____________________________________

You will be requested to analyze five (5) images. For each of the images you are requested to rate the technical adequacy of the film in the different areas listed below.

- anatomy coverage
- patient positioning
- film exposure
- film contrast
- image sharpness
- identification requirement
- radiation protection measures

For each rating please provide a reason for your rating.

Key

1. Poor
2. Moderate
3. Good
4. Very good
5. Excellent

No	Factors	Image 1					Reason for rating
		1	2	3	4	5	
1	Anatomy coverage						
2	Patient Positioning						
3	Exposure						
4	Contrast						
5	Sharpness						
6	Identification						
7	Radiation protection						

No	Factors	Image 2					Reason for rating
		1	2	3	4	5	
1	Anatomy coverage						

2	Patient Positioning						
3	Exposure						
4	Contrast						
5	Sharpness						
7	Identification						
8	Radiation protection						

No	Factors	Image 3					Reason for rating
		1	2	3	4	5	
1	Anatomy coverage						
2	Patient Positioning						
3	Exposure						
4	Contrast						
5	Sharpness						
7	Identification						
8	Radiation protection						

No	Factors	Image 4					Reason for rating
		1	2	3	4	5	
1	Anatomy coverage						
2	Patient Positioning						
3	Exposure						
4	Contrast						
5	Sharpness						
7	Identification						
8	Radiation protection						

No	Factors	Image 5					Reason for rating
		1	2	3	4	5	
1	Anatomy coverage						
2	Patient Positioning						
3	Exposure						
4	Contrast						
5	Sharpness						
7	Identification						
8	Radiation protection						

APPENDIX 7: PARTICIPANTS INFORMATION SHEET

School of Medicine
Department of Medical Education Development

PARTICIPANT INFORMATION SHEET

STUDY TITLE AND AIM

<u>Study title</u>

"Role of Workplace-Based Assessment of Radiographers in Informing Curriculum Development Practices: A Plain X-ray Technical Sufficiency Exemplar using 2010-2015 Post-Registration Radiographers"

<u>Study aim</u>

The purpose of the study is to improve radiography practice and training by contributing to the body of evidence that can inform better curriculum development policy at TEVETA and other universities planning to introduce radiography training.

<u>INVITATION</u>

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following carefully and consider whether you wish to participate. Please do not hesitate to contact me if anything is unclear or if you would like some more information.

The study is a part requirement for the award of PhD Degree in Medical Education being offered at the University of Zambia School of Medicine.

<u>PARTICIPANTS' RIGHTS</u>

I will state that participating in this study will be completely voluntary. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving reasons. This will not affect you in any way. You have the right to ask that any data you have contributed to that point be withdrawn/destroyed. You will still be respected for your contribution without any penalty. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study session begins.

<u>WHAT WILL HAPPEN & TIME COMMITMENT</u>

This study is divided into four phases.

Phase 1:

The objective of the first phase will be to build consensus on contemporary job requirements of a radiographer in the Zambian healthcare setting. A qualitative approach using a Delphi technique will be used. If you participate in this phase you will be required to complete a questionnaire. You will be sent compiled responses and your option sought again until consensus is achieved.

Phase 2 A

This phase will seek to explore the perception of Zambian radiographers with respect to performance against the agreed job requirements. Focus group discussions will be conducted to elicit their perceptions. In this phase, you will be required to take part in FGD. Each FGD is scheduled to take about 45 minutes.

Phase 2B

In this phase, the perceptions of radiographers with respect to performance against agreed job requirements will be tested in the greater population of radiographers. This will be undertaken using Non-experimental, descriptive and Cross-sectional approach using a self-administered questionnaire. The questionnaire will take about 30 minutes to complete

Phase 3

The objective of this phase will be to implement a WBA in the area of radiograph technical sufficiency and to compare performance in the assessment to the self-assessment. The WBA will be focused on chest radiograph evaluation for quality. The assessment is divided into two parts. The first part will require you to complete a questionnaire requesting for demographic data, work experience and also assessing your knowledge of evaluation criteria for a chest radiograph. The second part will require you to review images and record your responses. The total time required will be approximately 2 hours.

NB. Your participation may be required in more than one phase of the study.

CONFIDENTIALITY/ANONYMITY

Anonymity and confidentiality will be maintained and ensured throughout the whole process. All the information which is collected about you during the course of the research will be kept confidential. Your name will not be on the tape or transcript and all recordings and transcriptions will be number coded to ensure confidentiality. The data will be collected by the researcher and will be accessible by the researcher only.

BENEFITS AND RISK

There will be no direct benefit for you. However, the results from the study may inform curriculum development policy which will benefit those in training. There is no risk posed to you as a participant.

FURTHER INFORMATION

Should you require further information please do not hesitate to get in touch with me or my supervisor using the details below.

Student

James M. Sichone
Email: jmaimbos@yahoo.com
Mobile: +260979548784
P.O. Box 51337
Cancer Diseases Hospital
Lusaka

Supervisor

Professor Sekelani S. Banda
National Training Coordinator
Ministry of Health
Mobile:+260966758833
Email: ssbanda2007@gmail.com

Queries may also be directed to the Chairperson of the Research Ethics Committee:
Chairperson
The University Of Zambia
Biomedical Research Ethics Committee
PO Box 50110 Ridgeway Campus Lusaka,
Zambia,
Telephone: 256067,
E-mail: unzarec@zamtel.zm

APPENDIX 8: CONSENT FORM

INFORMED CONSENT FORM

Research Title: Role of Workplace-Based Assessment of Radiographers in Informing Curriculum Development Practices: A Plain X-ray Technical Sufficiency Exemplar using 2010-2015 Post-Registration Radiographers

You are being asked to participate in the study captioned above. Signing this form indicates that

a. You have read and understood the participant information sheet
b. Questions about your participation in this study have been answered
c. You are aware of the potential risks (if any)
d. You will take part in this study voluntarily (without coercion)

__________________________ _____________________ ________________

Participant's Name Signature Date

Consent obtained by ____________________________ ____________________

Name Signature

APPENDIX 9: PERMISSION LETTER

James Sichone
Cancer Diseases Hospital
P.O. Box 51337
Lusaka
Zambia

Tel. +260979548784
Email: jmaimbos@yahoo.com

The Head of Institution
____
____

Dear Sir/Madam
SUBJECT: REQUEST FOR PERMISSION TO RECRUIT AND ADMINISTER RESEARCH STUDY AT YOUR INSTITUTION

Research Title: Role of Workplace-Based Assessment of Radiographers in Informing Curriculum Development Practices: A Plain X-ray Technical Sufficiency Exemplar using 2010-2015 Post-Registration Radiographers

I write to request permission to undertake theabove-noted research study in your institution. Permission is further requested to recruit radiographers in your institution into the said study. The aim of the study is to improve radiography practice and training by contributing to the body of evidence that can inform better curriculum development policy at TEVETA and other universities planning to introduce radiography training.

The study is a multiphase study. However, only the second and third study phases will require the input and participation of radiographers at your institution. No direct benefit will accrue to those participating. The hope is that information generated from this study will assist the radiography curriculum development process.

I would like to thank you in advance for your consideration of this matter.

Yours Sincerely,

James Sichone ____________________________________

APPENDIX 10: PARTICIPANTS INFORMATION SHEET, CONSENT & QUESTIONNAIRE

School of Medicine
Department of Medical Education Development

CONSENSUS BUILDING - SECOND DATA COLLECTION PHASE.

PARTICIPANT INFORMATION SHEET

We would like to thank you for participating in the study "Role of Workplace-Based Assessment of Radiographers in Informing Curriculum Development Practices: A Plain X-ray Technical Sufficiency Exemplar using 2010-2015 Post-Registration Radiographers". Following the first round of data collection using the Delphi technique approach in which you participated, data collected were analysed and summarized. In order to build consensus, circulation of the findings is being made.

You are being invited to review the summarized findings and to comment. You are free to agree or disagree with the summarised views.

PARTICIPANTS' RIGHTS

I will state that participating in this study will be completely voluntary. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving reasons. This will not affect you in any way. You have the right to ask that any data you have contributed to that point be withdrawn/destroyed. You will still be respected for your contribution without any penalty. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study session begins.

WHAT WILL HAPPEN & TIME COMMITMENT

This study is divided into four phases. Data collection at this point is for phase 1 of the study

Phase 1:

The objective of the first phase will be to build consensus on contemporary job requirements of a radiographer in the Zambian healthcare setting. A qualitative approach using a Delphi technique will be used. If you participate in this phase you will be required to complete a questionnaire. You will be sent compiled responses and your option sought again until consensus is achieved.

CONFIDENTIALITY/ANONYMITY

Anonymity and confidentiality will be maintained and ensuredthroughout the whole process. All the information which is collected about you during the course of the research will be kept confidential. Your name will not be on the tape or transcript and all recordings and transcriptions will be number coded to ensure confidentiality. The data will be collected by the researcher and will be accessible by the researcher only.

BENEFITS AND RISK

There will be no direct benefit for you. However, the results from the study may inform curriculum development policy which will benefit those in training. There is no risk posed to you as a participant.

FURTHER INFORMATION

Should you require further information please do not hesitate to get in touch with me or my supervisor using the details below.

Student

James M. Sichone
Email: jmaimbos@yahoo.com
Mobile: +260979548784
P.O. Box 51337
Cancer Diseases Hospital
Lusaka

Supervisor
Professor Sekelani S. Banda
National Training Coordinator
Ministry of Health
Mobile:+260966758833
Email: ssbanda2007@gmail.com

Queries may also be directed to the Chairperson of the Research Ethics Committee:
Chairperson
The University Of Zambia
Biomedical Research Ethics Committee
PO Box 50110 Ridgeway Campus Lusaka,
Zambia,
Telephone: 256067,
E-mail: unzarec@zamtel.zm

APPENDIX 11: COMPETENCE PROFILE

Section A: Core role description

Refined description

‘‘The primary role of radiographers is to assess patients and their clinical requirements in order to apply the appropriate radiographic techniques; pursuant to producing Images of diagnostic value, furthermore, to undertake additional roles that enhance radiography service delivery subject to appropriate training’’

Competence categories

A radiographer would undertake a number of other roles and responsibilities, some of which would affect their primary role directly, others indirectly. These could be grouped into the following categories:

Refined categories
Professional
Clinical
Interpersonal
Patient care
Technical
Administrative/Management
Training/Education
Research

Based on the initial survey the following categories were identified with their associated roles and responsibilities.

Category	Roles and responsibilities
Professional	Technical competence
	Promotion of radiography profession
	Adherence to quality standards
	Affiliation to professional body

	Appropriately qualified
	CPD & Career development
	Observe code of ethics
	Observe code of conduct
	Adherence to QA and Quality improvement
	Compliance with regulation
	Multidisciplinary approach to care
	Conduct research and Development of protocols
	Adhere to radiation protection practices
Clinical	Perform radiographic examinations in order to produce images of diagnostic value
	Undertake film reporting
	Provide Innovation to the radiographic diagnostic process
	Work multidisciplinary manner in order to ensure best practice
	Practice high level of infection prevention
	Operate equipment in a safe and efficient manner
	Provide appropriate patient care
	Assess and evaluate patient prior to undertaking procedures
	Practice according to standard operating procedures
	Ensure adherence to radiation protection measures
Interpersonal	Multidisciplinary approach
	Practice Emotional intelligence
	Effective Communication with patients and staff
	Conflict management
	Good listener
	Learning mentality
	Respect others
	Team player

	Valuing cultural diversity
Patient care	Provide appropriate care according to need
	Ensure holistic care approach is taken
	Information provision & consent
	Patient assessment
	Patient privacy and confidentiality
	Patient comfort, safety and security
	Provision of efficient service
	Psychological care
	Radiation protection
	Infection prevention
Technical	Part of the care and maintenance programme
	Implement equipment QA programme
	Implement image quality management
	Participate in clinical Audit activities
	Technical support (mentorship)
	Technical support (policy and procurement)
	Technical competence to understand and operate high technological equipment
	Ensure patient safety and security
Administration and management	Budget and planning
	Leadership and directing of radiography services
	Resource mobilization and management
	Stock and inventory management
	Programming, scheduling and workflow management
	Departmental organization and coordination
	human resource management (capacity building, planning, appraisal)
	Data and record management

	QA programme implementation
	Equipment management and planning
Training and education	Supervision and training of students on clinical rotation
	Engaging in CPD activities (seminars, workshop etc)
	Patient and care giver education
Research	Support research activities in radiography
	Undertake research
	Publications

Future roles that were listed from the initial survey include;

xii) Film reporting
xiii) Equipment maintenance
xiv) Disease survey and monitoring
xv) Independent research
xvi) Performance of special studies independent of medical officers
xvii) Phlebotomy
xviii) Management of contrast side effects
xix) Forensic radiography practice
xx) PACs & RIS management

APPENDIX 12: TOOL FOR CURRICULUM MAPPING AND COMPARISON WITH DEVELOPED COMPETENCIES

Year of study	Module	Hours	Overall objective	Competencies	Categorization of competencies			Hierarch			Category in the developed Job competency list
					Cognitive	Psychomotor	Affective	Low	Moderate	High	

APPENDIX 13: ETHICS APPROVAL LATTER

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

10th August, 2017.

Your Ref: 012-06-17.

Mr. James M. Sichone,
University of Zambia,
Department of Medical Education Development,
P.O Box 51337,
Lusaka.

Dear Mr. Sichone,

RE: RESUBMITTED RESEARCH PROPOSAL: "ROLE OF WORKPLACE BASED ASSESSMENT OF RADIOGRAPHERS IN INFORMING CURRICULUM DEVELOPMENT PRACTICES: A PLAIN X-RAY TECHNICAL SUFFICIENCY EXEMPLAR USING 2010 -2015 POST-REGISTRATION RADIOGRAPHERS" (REF. 012-06-17)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 1st August, 2017. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- Apply in writing to National Health Research Authority for permission before you embark on the study.
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

Dr. S. H Nzala PhD
VICE-CHAIRPERSON

Date of approval: 10th August, 2017. **Date of expiry:** 9th August, 2018.