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DISSECTING THE GROSS ANATOMY CURRICULUM AND PEDAGOGY FOR SOUTH AFRICAN PHYSIOTHERAPY STUDENTS

Dorothy Agnes Shead

A thesis submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of Doctor of Philosophy.

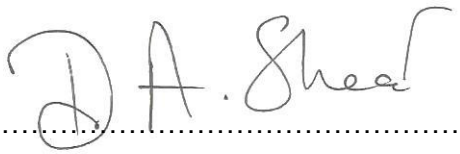
Johannesburg, 2019

DECLARATION

I, Dorothy Agnes Shead, declare that the work contained in this thesis is my own work, except to the extent indicated in the acknowledgement section.

It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg, South Africa.

This work has not been submitted before for any degree or examination at this or any other University.



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Signature of Candidate

19 February 2019

DEDICATION

This thesis is dedicated to the memory of the cadaver who was my first teacher and patient. I thank him for setting me on this path of anatomical and clinical discovery.

PEER-REVIEWED PUBLICATIONS AND CONFERENCE PROCEEDINGS EMANATING FROM THE WORK CONTAINED IN THIS THESIS

PEER-REVIEWED PUBLICATIONS

Shead D, Roos R, Olivier B, Ihunwo AO 2016 Gross anatomy curricula and pedagogical approaches for undergraduate physiotherapy students: a scoping review protocol. *JBI Database of Systematic Reviews and Implementation Reports* 14(10): 98-104.

Shead DA, Roos R, Olivier B, Ihunwo AO 2018 Curricular and pedagogical aspects of gross anatomy education for undergraduate physiotherapy students: A scoping review. *JBI Database of Systematic Reviews and Implementation Reports* (*Under review).*

Shead DA, Roos R, Olivier B, Ihunwo AO 2018 Gross anatomy education for undergraduate South African physiotherapy students. *Anatomical Sciences Education (Published online 16 January 2018, doi: 10.1002/ase1763).*

Shead DA, Roos R, Olivier B, Ihunwo AO 2018 Learning styles of physiotherapy students and teaching styles of their lecturers in undergraduate gross anatomy education. *African Journal of Health Professions Education* (*In press* doi: 10.7196/AJHPE.2018.v1014.1070).

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Presented by: Dorothy Shead
Authors: Dorothy Shead, Ronel Roos, Benita Olivier and Amadi. O Ihunwo

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Presented by: Dorothy Shead
Authors: Dorothy Shead, Ronel Roos, Benita Olivier and Amadi. O Ihunwo

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To be presented by: Dorothy Shead

Authors: Dorothy Shead, Ronel Roos, Benita Olivier and Amadi. O Ihunwo

CONTRIBUTIONS OF AUTHORS TO THE PROJECT

As part of the declaration of this thesis I acknowledge contributions to this work by various individuals as detailed below:

The experimental design, methods of data collection and statistical analysis undertaken for the entire research project were devised by myself in conjunction with my supervisors Dr Ronel Roos[1], Associate Professor Benita Olivier[1] and Professor Amadi Ihunwo[2].

Systematic data base searches and collation of the results was carried out by myself. Dr Ronel Roos[1] and Associate Professor Benita Olivier[1] fulfilled the roles of second reviewer and third reviewer respectively.

I was responsible for the design of the REDCap electronic survey questionnaire but all authors reviewed the survey document prior to its circulation. Permission to distribute the survey specific gross anatomy coordinators and electronic distribution and collection of the survey data were handled by myself.

Focus group organisation, qualitative data collection, verbatim transcription and verbatim transcript coding was conducted by myself. Dr Ronel Roos[1] acted as the second coder during the grounded theory process.

I was responsible for the drafting of all written work including the literature review, papers for publication submission and re-submission. All authors reviewed the drafts before they were submitted for publication. All supervisors reviewed the drafts for Study 3.

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ABSTRACT

Physiotherapists require sound and detailed gross anatomical knowledge to prepare them for safe and competent clinical practice. In South Africa physiotherapy (PT) practitioners are autonomous and provide first line care for patients. In this role they can diagnose a patient's condition and treat to restore optimal function within the boundaries of their scope of practice. Undergraduate students in this country receive gross anatomy education in the first and/or second year of their PT course. The significance of this research lies in the fact that it addresses the need for a comprehensive perspective on a unified national approach to a gross anatomy curriculum for undergraduate PT students in South Africa. It also identifies the pedagogies best suited for the delivery of such a curriculum to this student body. Studies included in this thesis document facts relating to gross anatomy education for the undergraduate PT student body globally, information from national PT student gross anatomy coordinators and qualified South African physiotherapists and consider the relevance of the relationship between the learning styles of undergraduate PT students and the teaching styles of their gross anatomy lecturers. In South Africa there are eight Health Science Faculties that offer an anatomical grounding to undergraduate PT students as part of baccalaureate courses. They are widely distributed throughout the country. Gross anatomy programmes vary widely in curriculum design and pedagogy used. This thesis brought together global and national perspectives on the topic in order to formulate a unified national approach to gross anatomy education for South African undergraduate PT students.

The thesis consisted of four studies that were grouped into Phase 1 (Studies 1 and 2) and Phase 2 (Studies 3 and 4). Four original papers resulted from the findings of Studies 1, 2 and 4.

Paper 1 (Appendix 1) of this thesis is a protocol document developed to guide the scoping review process in Study 1. The preparation of the Joanna Briggs institute protocol and charting template ensured that the scoping review that was subsequently carried out followed a systematic, verifiable methodology.

Paper 2 (Chapter 3), a scoping review, systematically sourced published or unpublished literature in all languages prior to 20 March 2018, to ascertain the gross anatomical education afforded to undergraduate PT students in the global context. The collation of 1241 sourced documents identified 51 eligible papers for inclusion. Papers were charted into eight categories according to the main focus of the intervention undertaken. Mean sample sizes varied from (216.9 ± 241.3) in the inter-professional category to (55.3 ±30.4) in the ethical, professional and psychological matters category. Overall 26 study samples (51.0%) had

input from PT students or PT professionals exclusively in the sample. Key findings emphasised: the relevance of gross anatomy in PT education and how inter-professional education and clinical input in the form of case-base learning factored into this scenario; the increase in computer-assisted learning; the beneficial use of team-based learning and peer teaching; enhancement of professional behaviours during dissection and improved student attitudes to ethics and perceptions of the dignity of human life. These findings were used to compare the global gross anatomy situation with the findings of the national gross anatomy survey undertaken in Paper 3 (Chapter 4).

Paper 3 (Chapter 4), a 42-question peer-reviewed online survey established gross anatomy curriculum and pedagogy content for South African undergraduate PT students at all eight relevant Health Science faculties in South Africa**.** Seven coordinators from six (75%) of the universities responded. Collected data showed that staff qualifications and experience varied widely and high to average staff to student ratios existed between faculties. Total number of weeks in courses per year was 27.6 (± 5.7) varying widely between institutions. Calculable direct contact anatomy hours ranged between 100 and 308 with a mean of 207.6 (±78.1). With the exception of one faculty this is high in comparison to global standards as reported in Paper 2. The main difference noticed between the pedagogy in use globally and locally was that computer-assisted learning was used liberally in the global setting but due to budget constraints only half of the responding faculties used it in South Africa. The findings highlighted disparity between national programmes and therefore confirmed the significance of the study in relation to the identification and formulation of a unified curriculum for the country.

The third study (Chapter 5) established what South African physiotherapists in different service delivery spheres, in the Gauteng Province of South Africa, perceived as necessary content for a gross anatomy curriculum and pedagogy for South African PT students. This study used a qualitative grounded theory approach and was conducted using focus group discussions. The sample was PT lecturers, at the University of the Witwatersrand (WITS) and physiotherapists in public hospitals and private practices in Gauteng. Theoretical saturation dictated number of participants and focus groups. Data collection and analysis were simultaneous. Data analysis was inductive to establish themes. Reliability and strength of research factors were implemented. Five focus groups were held (n=32). Overall average age of participants was 29.9 (± 7.8) years and physiotherapy experience was 7.4 (± 7.7) years. The public sector particpants had the lowest mean age of 24.2 (± 2.4) years. Recorded years of experience was highest in the private sector at 12.7 (±7.3). There were more female participants and clinical work areas were diverse in scope of practice. All pedagogies named by participants were in line with the global and national findings (Papers

2 and 3). The suggested anatomy programme content inclusion and exclusion mirrored that suggested in both the global and national perspectives (Papers 2 and 3). The psychological wellbeing of PT students in relation to dissection and coping with ‘anatomy overload’ was raised in the discussions. Seven themes were identified. This study added depth to the overall thesis by incorporating the essential viewpoint of qualified physiotherapists who have the advantage of knowing what is clinically required to ensure effective, professional and competent PT practice post qualification.

Paper 4 (Chapter 6) determined the different gross anatomy learning styles utilised by two chronological South African undergraduate PT student cohorts enrolled at WITS and identified the different teaching styles utilised by the gross anatomy instructors, involved in the teaching of those students in the School of Anatomical Sciences at WITS. This study design was cross-sectional and data were collected using the standardised Grasha-Riechmann learning style scale (GRLSS) and the Grasha-Riechmann teaching style scale (GRTSS) questionnaires. The key findings from this study offered insight into the type of learning styles PT students use to learn gross anatomy. Student samples were small (Group 1, n=59 and Group 2, n=54) but response rates high (n=39, 66.1% and n= 43, 81.5%) in 2015 and 2016. Mean Likert scores for GRLSS indicated most popular choice for learning style was the Dependent style: 3.81(0.75) for Group 1 and the Independent style: 3.68(0.61) for Group 2. Both gender and age factors influenced the results but no significant differences were recorded in GRLSS scores for the different age groups. Lecturers scored highest in the Expert category of teaching styles. Compatibility between learning and teaching styles was seen in both years when identified GRLSS and GRTSS styles were grouped together into specific cluster categories. One member of staff had ‘accomodated’ to a different teaching style cluster in 2016 more suited to the Independent learning style of student Group 2.These findings may impact on the types of pedagogy chosen to best suit student group learning. However, the increase number of students in anatomy classes as indicated in both the global literature and the national survey and the general diversity of student learning style preference may lead to the conclusion that there is no ‘one size fits all’ strategy that can be implemented to ensure all student learning style needs are met.

In conclusion the research strategy undertaken fulfilled the aims and objectives of the project. The addition of a qualitative component in the gathering of the data added a further dimension and depth to the research. Overall there is identification of plausible, beneficial and implementable curricular and pedagogical suggestions that can be presented to relevant tertiary and governmental bodies in order to help facilitate a unified national gross anatomy educational programme for undergraduate PT students in South Africa.

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LIST OF ABBREVIATIONS

AACA	- American Association of Clinical Anatomists
AAMC	- Association of American Medical Colleges
AC	- Abstract Conceptualization
ACL	- Anterior Cruciate Ligament
ADAM	- Animated Dissection of Anatomy for Medicine
AE	- Active Experimentation
AMA	- American Medical Association
APA	- Australian Physiotherapy Association
APTA	- American Physical Therapy Association
ARS	- Audience Response System
ASSA	- Anatomical Society of Southern Africa
CAIPE	- Centre for the Advancement of Interprofessional Education
CAL	- Computer-Assited Learning
CAPTE	- Commisssion of Accreditation in Physical Therapy Education
CE	- Concrete Experience
CF	- Constructive Feedback
CL	- Commitment to Learning
CPD	- Continuing Professional Development
CSP	- Chartered Society of Physiotherapy
CT	- Critical Thinking
2D	- Two-Dimensional
3D	- Three-Dimensional
DPT	- Doctor of Physical Therapy
EBP	- Evidence-Based Practice
ECE	- Early Clinical Exposure
EPPI	- Evidence Informed Policy and Practice
EPTAI	- Expert Physical Therapy Anatomy Instructors
ET	- Effective use of Time and Resources
FG	- Focus Group
GPTAI	- General Physical Therapy Anatomy Instructors
gRAT	- Group Readiness Assurance Test
GRLSS	- Grasha-Riechmann Learning Styles Scale
GRTSS	- Grasha-Riechmann Teaching Style Survey
HOD	- Head of Department
HOS	- Head of School
HPCSA	- Health Professions Council of South Africa

HuGA	- Humanities in Gross Anatomy Project
ICAL	- Interactive Computer-Assisted Learmimg
IEPS	- Interdisciplinary Education Perception Scale
IPE	- Interprofessional Education
iRAT	- Independent Readiness Assurance Test
IRB	- Institutional Review Board
IS	- Interprofessional Skills
JBI	- Joanna Briggs Institute
KLSI	- Kolb's Learning Style Inventory
MCOE	- Muscle Cut-Out Exercise
MCQs	- Multiple-Choice Questions
MEDUNSA	- Medical University of Southern Africa
MPT	- Master of Physical Therapy
MRI	- Magnetic Resonance Imaging
OP	- Occupational Therapy
PBL	- Problem-Based Learning
PNZ	- New Zealand Physiotherapy Association
PRS	- Peer Review Sessions
PS	- Problem Solving
PT	- Physiotherapy
QoL	- Quality of Life
QR	- Quck Response
RCT	- Randomised Controlled Trial
RECap	- Research Electronic Capture
RIPLS	- Readiness for Interprofessional Learning Scale
RO	- Reflective Observation
RPT	- Recipricol Peer Teaching
SASP	- South African Society of Physiotherapy
SI	- Self Instruction
SM	- Stress Management
SMU	- Sefako Makgatho University
SUN	- Stellenbosch University
TBL-SAI	- Team-based Learning Student Assessment Instrument
TPS	- Total Professionalism Score
UCT	- University of Cape Town
UFS	- University of the Free State
UK	- United Kingdom
UKZN	- University of Kwa-Zulu Natal

USA	- United States of America
UWC	- University of the Western Cape
VARK	- Visual, Aural, Read/write, Kinaesthetic Model
VIP	- Varied-Integrative-Progressive
WHO	- World Health Organisation
WITS	- The University of the Witwatersrand
WCPT	- The World Confederation for Physical Therapy

LIST OF TERMINOLOGY USED

Abstract Conceptualisation (AC)(Kolb, Boyatzis and Mainemelis, 1999): This is one of the concepts included in Kolb's experiential learning style model and is the creation of theories to explain what has been observed and the development of conclusions from such observations.

Active Experimentation (AE)(Kolb, Boyatzis and Mainemelis, 1999): This term is included as a Kolb experiential learning style model and incorporates the use of planning, advancing theories to solve problems, make decisions and implementing and testing what has been learned.

*Audience Response System (ARS)(*Wait et al, 2009): creates interactivity between a presenter and an audience. In the case of an educational environment students can use a hand held remote control device to convey their responses to questions. This device is often called a "clicker."

*Concrete Experience (CE)(*Kolb, Boyatzis and Mainemelis, 1999): This is one of the concepts included in Kolb's experiential learning style model and is the doing or having a new experience.

Doctor of Physical Therapy (DPT)(Mathur, 2011): This is an entry-level degree pertaining to the obtaining of a clinical or practice doctorate in the field of PT. It is not the same as a PhD degree that focuses on research and adds to the volume of original research literature in clinical and non-clinical areas.

Early Clinical Exposure (ECE)(Prithishkumar and Holla, 2012): The horizontal integration of clinical case studies into an anatomy programme where PT students are exposed to clinical conditions relevant to the anatomy topic being studied at the time.

Evidence-Based Practice (EBP)(Biesta, 2007): integrates clinical expertise, proven research evidence and patient needs for improved patient care.

Grasha-Riechmann Learning Style Scale (GRLSS)(Smith and Dalton, 2005; Cassidy, 2004; Grasha, 1996; Curry, 1983): This is a standardized questionnaire with 60 statements and is designed to assess six different learning styles.

Grasha-Riechmann Teaching Style Scale (GRTSS)(Grasha and Riechmann-Hruska, 1996): This is a standardized questionnaire and is designed to assess four different teaching styles.

*Group Readiness Assurance Test (gRAT)(*Huitt, Killins and Brooks, 2015): This test is used in team-based learning scenarios and conducted prior to the commencement of the course. Marks can contribute to student grades. Tests are usually multiple-choice and a "scratch-off" sheet is often used. Students can mark themselves enabling group discussion about answers.

*Individual Readiness Assurance Test (iRAT)(*Huitt, Killins and Brooks, 2015): This test is also used to assess students' readiness to participate in a team-based learning exercise.

Interdisciplinary Education Perception Scale (IEPS)(Fernandes et al., 2015): was developed to measure professional perceptions and other closely related matters for those taking part in interdisciplinary education programmes. It is a 12-item tool and can be used to measure interprofessional education outcomes pertaining to undergraduate students. It has 4 subscales: 'competency and autonomy, perceived need for cooperation and perception of actual cooperation and understanding others' roles.'

*Readiness for Interprofessional Learning Scale (RIPLS)(*Fernandes et al., 2015): This scale measures how students perceive and react to the effects of various interventions and changes in attitudes in order to assess their readiness for interprofessional learning. The tool has 19 items designed to measure health care students' readiness for such education. There are three subscales: 'teamwork and collaboration, negative and positive professional identity, and roles and responsibilities.'

*Reflective observation (RO)(*Kolb, Boyatzis and Mainemelis, 1999): Another Kolb experiential learning style theory involving the watching of others or development of observations about one's own experience. A reflective process with review is implemented.

Scoping review: (Arksey and O'Malley, 2005): A scoping review is a systematic acquisition of literature pertaining to a policy or clinical area. The objective of the exercise is to accumulate the diverse evidence as quickly as possible and chart the results. There is no analysis of the quality of the literature presenting the evidence.

*Team-Based Learning Student Assessment Instrument (TBL-SAI)(*Livingston, Lundy and Harrington (2014): This tool consists of 33 questions found in three subscale categories measuring: 1) student preparation for class and team contribution; 2) students' information

retention and attention level in team-based learning and lectures and 3) the level of student satisfaction with team-based learning.

Reference list

References pertaining to the list of terminology used are included in the reference list after Chapter 2 (literature review).

CHAPTER 1

1. INTRODUCTION

1.1 PREFACE

The learning of gross anatomy is an integral part of a South African undergraduate physiotherapy (PT) student's baccularеate degree. The inclusion of a gross anatomy programme in the early years of a PT course ensures that the student has an inherent knoweldge of the human body with regard to its structure and the relationships between anatomical structures and the way in which they function. Physiotherapy practice in South Africa because of its autonomous nature requires students to obtain anatomical competency that prepares them for safe clinical effectiveness while acting as an independent healthcare professional. It is therefore important that the gross anatomy curricular content is tailored to the needs of this specific student body. The way in which the subject is taught can also largely impact on retention of necessary anatomical knowledge. Furthermore, if optimum curricular content and delivery methodology can be identified it can be factored into a unified gross anatomy programme design for the country resulting in the realisation of a higher standard of gross anatomy retention and application by physiotherapy students.

1.2 PROBLEM STATEMENT

The importance of gross anatomy as the foundation for a medical education is well known and it is linked to competency in the clinical sphere. There is a paucity of information in the literature pertaining to the gross anatomy education of undergraduate PT students globally. In particular, pedagogical and curricular factors relating to the learning of this subject by the South African undergraduate PT student population is under investigated and unclear.

1.3 RESEARCH QUESTIONS

The following research questions were addressed by means of four studies:

Study 1:

a) What is the gross anatomy curriculum and pedagogy for undergraduate PT students globally?

Study 2:

b) What is the gross anatomy curriculum and pedagogy for South African undergraduate PT students?

Study 3:

c) What do physiotherapists in the public, private and academic service delivery sectors in the Gauteng Province of South Africa perceive as necessary content for a gross anatomy curriculum and pedagogy for South African undergraduate PT students**?**

Study 4:

d) How do the learning styles of second year undergraduate PT students learning anatomy in the School of Anatomical Sciences at WITS and the teaching styles of their anatomy lecturers compare and how can these data influence the choices of anatomy pedagogy for this population of students?

1.4 AIMS OF THE THESIS

The aims of this thesis were to:

- Investigate the gross anatomy curriculum and pedagogy for undergraduate PT students globally as well as specifically for South African undergraduate PT students
- Investigate the factors that may influence the gross anatomy curriculum and pedagogy adopted for South African undergraduate PT students at WITS Johannesburg, South Africa

1.5 OBJECTIVES OF THE THESIS

The objectives of this thesis were to:

Papers 1 and 2 (Appendix 1 and Chapter 3)

- Determine the gross anatomy curriculum and pedagogy content for undergraduate PT students globally.

Paper 3 (Chapter 4)

- Determine the gross anatomy curriculum and pedagogy content for South African undergraduate PT students at Health Science faculties in South Africa**.**

Study 3 (Chapter 5)

- Establish what South African physiotherapists in different service delivery spheres, in the Gauteng Province of South Africa, perceive as necessary content for a gross anatomy curriculum and pedagogy for South African PT students.

- Establish what lecturers in the Physiotherapy Department at WITS believe a gross anatomy curriculum should include for South African PT students.

Paper 4 (Chapter 6)

- Determine the different gross anatomy learning styles utilised by South African undergraduate PT students enrolled at WITS.
- Determine the different teaching styles utilised by the gross anatomy instructors, who are involved in the teaching of South African undergraduate PT students**,** in the School of Anatomical Sciences at WITS.

The overall outcome of the thesis was to:

- Identify plausible, beneficial and implementable curricular and pedagogical suggestions that can be presented to relevant tertiary and governmental bodies in order to help facilitate a unified national gross anatomy educational programme for undergraduate PT students in South Africa.

1.6 SIGNIFICANCE OF THE RESEARCH

The thesis aims to review and document the research presented in the global literature pertaining to gross anatomy education for the undergraduate PT student body. In so doing it will present an up-to-date synopsis of pedagogies and curricular models used in this type of education. It will also add to the pool of global literature on the topic and will facilitate comparisons to be made between the global picture and the South African situation investigated by means of a national gross anatomy survey carried out in this thesis. The survey will enable a recent perspective on the state of gross anatomy education for PT students in this country to be obtained. Furthermore, as the future clinical application of gross anatomy knowledge is relevant in anatomy education the opinions of qualified physiotherapists working in various service delivery sectors will provide the much-needed clinical perspective on the topic. The incorporation of this aspect of the research will direct the formulation of a suggested unified curriculum towards being clinically relevant. In addition, the learning style preferences exhibited by PT students and the teaching style preferences of their gross anatomy lecturers may give an indication as to the best way in which the anatomy knowledge is conveyed to the students. Overall, this thesis endevours to create a suggested framework for a unified teaching approach for the gross anatomy education of undergraduate PT students in South Africa by combining all the afore-mentioned aspects of the research. The outcomes of this research will offer new insights into the way in which undergraduate PT students are taught anatomy nationally and internationally and it will suggests ideas which may be implemented

within Schools of Anatomical Sciences throughout South Africa to improve the learning outcomes and university throughput for this population of students.

1.7 ETHICAL CONSIDERATIONS FOR THE ENTIRE THESIS

The thesis was submitted to the Human Research Ethics Committee (Non-Medical) of the University of the Witwatersrand, Johannesburg, South Africa and ethical clearance was granted (clearance certificate; H15/04/12 (Appendix 2)). Approval of the title of the research project was obtained (Appendix 3). Permission was granted by the registrar of the University of the Witwatersrand for the research to be carried out at the University (Appendix 4).

1.7.1 All Four Studies

The University of the Witwatersrand's rules regarding plagiarism were observed.

1.7.2 Study 1 (Papers 1 and 2)

The University of the Witwatersrand's rules regarding plagiarism were observed.

1.7.3 Study 2 (Paper 3)

The Head of School (HOS) of Anatomical Sciences at WITS granted permission for the 2015 gross anatomy co-ordinator for undergraduate PT students to take part in an appraisal of the survey. The appraised survey document was sent to the gross anatomy co-ordinator participants at Health Science faculties nationally after permission for the distribution of the survey was granted by the HOS or Head of Department (HOD) of Anatomical Sciences at each of the Health Science Faculties to be surveyed. Written permission was obtained from the President of ASSA to conduct the research in departments of anatomy throughout South Africa (Appendix 5). Written information, that included further ethical considerations, was provided to possible participants (Appendix 6). The survey clearly stated at the top that completion of it implied informed consent (Appendix 7).

1.7.4 Study 3

Permission was obtained from the HOD of the PT department at WITS for the voluntary participation of the lecturers in the academic focus group. All focus group (FG) participants were given an informed consent form to complete that included specific informed consent for the use of a tape recording device (Appendix 8). An information document that included further ethical considerations for participants was given to all participants (Appendix 9). A cover sheet was provided to maintain privacy of the information gathered.

1.7.5 **Study 4 (Paper 4)**

Permission to distribute the questionnaire to undergraduate PT students was obtained from the HOD of the physiotherapy department, the HOS of Therapeutic Sciences and the Dean of Student Affairs. Permission to distribute the questionnaire to lecturers in gross anatomy was obtained from the HOS of Anatomical Sciences at WITS. Written information, including further ethical considerations for student and lecturer participants in 2015 and 2016 (Appendices 10-13) and verbal information was provided. An A4 cover sheet was provided to maintain the privacy of particpants' information. Completion of the standardised GRLSS and GRTSS questionnaires implied informed consent.

1.8 **OUTLINE OF THE THESIS**

The learning of gross anatomy is an integral part of a South African undergraduate PT student's baccularеate degree. The inclusion of a gross anatomy programme in the early years of a PT course ensures that the student has an inherent knoweldge of the human body with regard to its structure and the relationships between anatomical structures and the way in which they function. Physiotherapy practice in South Africa because of its autonomous nature requires students to obtain anatomical competency that prepares them for safe clinical effectiveness while acting as an independent healthcare professional. It is therefore important that the gross anatomy curricular content is tailored to the needs of this specific student body. The way in which the subject is taught can also largely impact on retention of necessary anatomical knowledge. Furthermore if optimum curricular content and delivery methodology can be identified it can be factored into a unified gross anatomy programme design for the country resulting in the realisation of a higher standard of gross anatomy retention and application by PT students.

The general outline of the thesis is summarised below:

Chapter 1: Includes a preface to the thesis, a problem statement, the research questions, the aims and objectives of the research, the significance of the research, ethical considerations for the thesis and an outline of the thesis.

Chapter 2: Review of the literature relevant to this thesis. In Section 1 of the literature review curricular and pedagogical aspects of gross anatomy are presented including a detailed description of gross anatomy education, the challenges to its continuance in the present times, curricular designs, teaching methodologies, clinical implications for gross anatomy education and future directions for anatomy programmes. Section

2 looks at PT origins, clinical relevancy and educational developments globally. Section 3 describes relevant student learning style models.

Chapter 3: Paper 2 - This chapter consists of one original paper namely the scoping review. This paper documents the results of the scoping review carried out to ascertain an up-to-date global picture of gross anatomy education for undergraduate PT students.

Chapter 4: Paper 3 - Gross anatomy national survey. Chapter 4 consists of an original paper that records the results of a national gross anatomy survey carried out in 2016. The good response to the survey by the purposive gross anatomy coordinator sample gives some insight into the diversity in gross anatomy programme content and teaching methods or PT students in the country. However, it also identifies some common ground between programmes.

Chapter 5: Study 3 - Focus group discussions for qualified physiotherapists in service delivery sectors. This is a qualitative research record of the opinions of professional physiotherapists regarding gross anatomy curricular and pedagogical matters as they relate to undergraduate PT students. The themes generated by this research offer a unique insight into content and teaching methods best suited to the learning requirements of PT students in preparation for a future clinical role.

Chapter 6: Paper 4 - Collection of undergraduate PT students' learning styles (2015 and 2016) using the standardised Grasha-Riechmann Learning Styles Survey (GRLSS) questionnaire and the teaching styles of the gross anatomy lecturers (2015 and 2016) using the standardised Grasha-Riechmann Teaching Styles Survey (GRTSS) questionnaire. The original paper generated from this research identified specific learning style trends over two successive PT student cohorts. It also found particular teaching styles in gross anatomy lecturers and showed 'accomodation' in style by one of the lecturers to be more in keeping with the 2016 student cohorts' learning needs. Gender and age factors were considered in this research. Discrepencies in views regarding the efiicacy of using learning style research are also discussed.

Chapter 7: Discussion - An overall discussion of the significance and implications of the findings obtained in each section of the thesis is made. This chapter moulds together the pedagogical and curricular aspects of possible inclusons for a unified gross anatomy curriculum for South African PT students.

Chapter 8: Conclusions - Conclusions are drawn based on the methodical assimilation and interpretation of the findings of this thesis. Limitations of the research are also outlined.

Chapter 9: Recommendations - Curricular and pedagogical recommendations and recommendations for future research are made in this chapter.

Chapter 10: Appendices 1-20.

The flow diagram below illustrates the way in which the thesis was designed in order to address the research questions (Figure 1.1). The figure is labelled in accordance with its position in Chapter 1.

PHASE 1

QUANTITATIVE

Study 1 (Papers 1 and 2) (Scoping literature review)

Identification of search terms and phrases

Process undertaken to identify relevant search terms and phrases.

- Identified words or phrases n=23
- Arranged in five groups

Search of databases

Advanced search of databases undertaken

Included databases:

- Academic Search Complete
- CINAHL
- Education Search Complete
- ERIC
- MEDLINE
- PubMed
- SCOPUS
- Cochrane Reviews Database
- JBISRIR

PRISM flow diagram

A PRISM flow diagram was drawn up to show the collation of data.

Number of articles identified for inclusion by 20 March 20118 n=51

Tabulated summary of articles as per JBI guidelines

Journal articles tabulated and summarised according to the format for scoping reviews laid down by the JBI.

Information on international gross anatomy curricula and pedagogy for undergraduate physiotherapy students gathered from Paper 1 was used to direct the design of the gross anatomy survey in Study 2

Study 2 (Paper 3 (Gross anatomy survey)

Design of gross anatomy survey

Forty-two survey questions were entered into the Research Electronic Capture (REDCap) database to create a descriptive questionnaire.

Information gathered about;

- Staff and student demographics
- Pedagogy used to teach students
- Curricular aspects of anatomy education
- Adjunct teaching modalities
- Student assessment.

Internal reliability and **validity** of certain constructs appraised using Cronbach's alpha and Kendall's tau. **Peer review** Two senior anatomists and the 2015 gross anatomy coordinator for physiotherapy students at WITS. Two revisions of the original document were carried out

Distribution of survey: Survey was circulated to gross anatomy coordinators for undergraduate PT students at eight universities in South Africa.

Analysis of data: SPSS 24 statistical package

Outcome of Phase 1

- International trends in gross anatomy education for undergraduate physiotherapy students identified and documented.
- Information on present curricular and pedagogical aspects of gross anatomy education in South Africa for this student body collected and documented.
- Comparison between gross anatomy education globally and nationally established and forwarded into Phase 2 of the project to use as a guideline for qualitative FG research in Study 3 and help forge a link to student learning styles in Paper 4.

PHASE 2

QUALITATIVE

Study 3 (Focus groups)

Recruitment of participants: SASP bulk email, to all physiotherapists in Gauteng Province. Response n=7 Secondary recruitment process was purposive:

- Principal physiotherapist of private physiotherapy practices
- Head of department (HOD) of physiotherapists working in public hospitals
- Academic physiotherapists at WITS

Focus groups (FG)

- FG1: physiotherapists working in private practice
- FG2: physiotherapists working in public hospital that includes clinics
- FG3: physiotherapists working in private practice
- FG4: physiotherapists working in public hospital that includes clinics
- FG5: academic physiotherapists in PT department at WITS

Study procedure: Grounded theory utilised: Inductive and deductive process undertaken

- Initial open-ended questions identified
- Focus group session with field notes taken
- Written record of focus group reflections and memos made
- Verbatim transcript produced
- Verbatim transcript sent to second coder
- Coding of verbatim transcript by researcher with relevant quotations recorded in a coding table
- Meeting with other coder to establish inter-coder agreement
- Correction of coding table according to inter coder agreement.
- Revision of open-ended questions to accommodate identified codes.
- Next focus group session and repeated coding process
- Identification of subcategories
- Collapsing of subcategories into categories
- Identification of themes

QUANTITATIVE

Study 4 (Paper 4) (Learning styles and teaching styles survey)

Standardised questionnaires used for study

- Grasha-Riechmann Learning Styles Scales (GRLSS)
- Grasha-Riechmann Teaching Styles Survey (GRTSS)

Participants

- 2nd year undergraduate physiotherapy students learning gross anatomy at WITS in 2015 and 2016
- Lecturers teaching the physiotherapy students gross anatomy at WITS in 2015 and 2016

Distribution and collection of GRLSS and GRTSS

- September 2015
- August 2016

Analysis of data: SPSS 24 statistical package

Outcome of Phase 2

- Categories of information on qualified physiotherapists' opinions on gross anatomy curricular and pedagogical matters collected and processed using grounded theory.
- 2015 and 2016 learning styles of physiotherapy students and the teaching styles of the gross anatomy lecturers analysed

Outcome of Phase 1 + Phase 2

Collection of all data necessary to present answers to the project's research questions

Study outcome

Recommendations for a uniform gross anatomy education framework for undergraduate physiotherapy students in South Africa.

Figure 1.1: Flow diagram of Phases 1 and 2 of the Thesis

CHAPTER 2

2. LITERATURE REVIEW

INTRODUCTION

The literature review is divided into three sections. Section 1 provides information related to the definition of gross anatomy, curriculum and pedagogy in the context of gross anatomy education. It provides the historical background for the way in which anatomy education was established globally and its development. It conceptualises the relationship between the learning of gross anatomy and the clinical relevancy of the subject. Finally it outlines pedagogy used in gross anatomy programmes and other additions to such programmes to facilitate the teaching of undergraduate healthcare student populations.

It has to be stated that limited information is available specifically relating to undergraduate PT gross anatomy education but where possible the PT perspective is included. Section 2 describes PT educational and clinical practice guidelines and requirements. It is carried out to discuss the link of choice of gross anatomy programme content and teaching methodology (reported in Section 1) to a clinical scenario in order to achieve optimal learning outcomes that are best suited to safe PT practice.

Lastly, Section 3 looks at the learning styles and approaches that students can use to learn generally and in particular learn gross anatomy. Teaching styles are also described and the relevancy of matching teaching style to student learning style is discussed. Section 3 adds an insight into the way in which undergraduate PT students might learn gross anatomy and this, together with the information gleaned in Sections 1 and 2, produces a resultant overall picture that provides a guide as to how gross anatomy is best taught to this student population.

The figures and tables in Chapter 2 are labelled from 2.1 onwards in accordance with their position in the chapter.

METHODOLOGY OF THE LITERATURE REVIEW

In order to gather the literature for this chapter a comprehensive search of relevant databases was made. In particular a search was carried out in the Cochrane Database of Systematic Reviews, EBSCO Host (CINAHL, ERIC amd MEDLINE), Joanna Briggs Institute (JBI) database of Systematic Reviews and Implementation Reports, PubMed and SCOPUS databases as well as the Google Scholar search

engine. Specific websites were accessed to garner explanatory information or specific tests such as the JBI database, the WCPT, HPCSA and SASP. Further information was gathered from reading abstracts of congresses and from congress presentations, individual review of pertinent journal articles or books and individual review of specific researcher publications. Reference lists of sourced material were perused to gather more relevant publications. No date limitations for sourced information were applied.

2.1 SECTION 1: GROSS ANATOMY CURRICULUM AND PEDAGOGY

2.1.1 The Definition of Gross Anatomy and the Historical Origins of the Subject

The original term ‘anatomy’ is from the Greek word ‘anatomía’ and means to ‘cut up’ or ‘cut open’ (Khan et al., 2015). It therefore adhered strictly to the idea of dissection in its early beginnings (Snodgrass, 1951). However, as Snodgrass (1951) pointed out it is not rigidly associated with dissection. Gross anatomy has often been used in place of or confused with the term morphological anatomy but both names are used to describe the same concept. The Greek word ‘morphé’ refers to the form of the person and when used in the word morphology indicates a philosophical viewpoint of that form (Snodgrass, 1951). Therefore, gross anatomy can be defined as the study of the definitive internal and external structure of a human being that also takes into consideration the relationships between the anatomical structures and the function of such structures (Applegate, 2010).

Although dissection is still included in many gross anatomy programmes it is often used in conjunction with newer pedagogies. As an inclusion in the curricula for health care professionals, gross anatomy has been linked to human body structure that can be viewed using the naked eye in a topographical fashion and has been studied in a regional or systemic manner (Louw, Eizenberg and Carmichael, 2009). It is the first introduction to the structure of the normal human body for PT students and gives them a basis for comparison with and understanding of pathology and clinical conditions.

Throughout history anatomy has been the foundation of medical education (Papa and Vaccarezza, 2013; Sugand, Abrahams and Khurana, 2010). The earliest record of anatomical terminology was written on Egyptian medical papyri in 3000 BCE (Standring, 2016). Rituals for the dead in ancient Egypt incorporated a crude form of dissection (Shoja and Tubbs, 2007) but it appears that this bore no relationship to topographical anatomical learning (Standring, 2016). In the sixth century BCE Alcmaeon of Creton dissected non-human tissue as an intellectual exercise and his

writings influenced such luminaries as Hippocrates the ‘father of medicine’ (Standring, 2016). In parallel to the development of the awareness of anatomical knowledge in Greece and Egypt Ayurvodic medicine in India incorporated texts that contained important anatomical information and facilitated the understanding of anatomy (Loukas et al., 2010). Meanwhile, in ancient Persia anatomists were recorded taking part in human dissection (Shoja and Tubbs, 2007). The celebrated anatomist Galen lived for 50 years in the Roman Empire and taught his students the importance of anatomy for safe clinical practice (Standring, 2016). In the fifth century the fall of the Roman Empire led to the Dark Ages where scientific enquiry was stifled so the centre of scientific development moved to the east into Arabia. The advent of the Renaissance in the 12th century resulted in a rebirth of anatomical interest in Europe (Standring, 2016). In 1235 the anatomy curriculum was born when the first medical school was opened in Salerno in Italy (Papa and Vaccarezza, 2013). During the Middle Ages and the Renaissance period that followed in Europe the use of cadaver prosections were used to teach anatomy (Enke, 2005). In parallel with this development in the 16th century Vesalius was instrumental in fighting to get mandatory human anatomy dissection into the medical curriculum (Sugand, Abrahams and Khurana, 2010). In the 17th and early 18th century the training of medical physicians was mainly carried out in the UK and in Europe (Hildebrandt, 2010). A pioneer in this regard was a scot named William Hunter who in 1746 introduced the so called ‘Paris method of dissection’ to London where students were permitted to dissect human cadavers as opposed to just being instructed by cadaveric demonstration (Gefland, 1972). An American student physician called William Shippen Jnr studied under Hunter and upon his return to America established the first North American medical school in Philadelphia in 1765 (Hildebrandt, 2010). Preclinical medical education in the USA in the 1900s was dominated by anatomy (Drake et al., 2009) and consisted of lectures and laboratory dissection of cadavers (Louw, Eizenberg and Carmichael, 2009). In the early 1900s the American Medical Association (AMA) and the Association of American Medical Colleges (AAMC) were concerned about the number of sub-standard medical schools and the lack of conformity among them leading to wide disparity in medical education standards (Drake, McBride and Pawlina, 2014). These associations contacted the Carnegie Foundation who appointed Abraham Flexner to investigate this matter (Drake, McBride and Pawlina, 2014). Flexner’s comparisons of the medical education model in Germany and in the US resulted in his report formulated in 1910 (Weatherall, 2006). His report was extremely critical of the majority of medical schools in the USA and recommended that medical education should incorporate programmes of a high standard and be standardised (Drake, McBride and Pawlina, 2014; Flexner, 1910).

He also recommended that the entry-level requirement for USA medical schools should be a bachelor degree and anatomy should be included in the first two pre-clinical years and identified the need for a practical and more clinical form of learning with time and facilities for research.

In the UK it was only after the First World War in 1918 that the use of university courses for medical students with the inclusion of basic sciences and clinical experiences were proposed (Bonner, 1995). Anatomy education at that time was supported by the use of textbooks and the availability of models and specimens in anatomy department collections and museums (Hildebrandt, 2010). After World War II a standardisation of medical education that included two years of dissection was seen across the UK. However, the didactic and oversimplified way in which basic sciences such as anatomy were taught at that time led to a dissociation between what the students perceived as basic and sound knowledge of clinical conditions and the actual complex clinical pictures they encountered in practice (Weatherall, 2006).

Historically, in the South African context, the origins of the teaching of anatomy began in 1911 at the South African College, later called the University of Cape Town (UCT) (Correia, Wessels and Vorster, 2013). In 1919 an anatomy department was started at the South African School of Mines and Technology that later became WITS (Correia, Wessels and Vorster, 2013). The other medical schools that were established in South Africa were at: the University of Pretoria (1943), the University of Stellenbosch (1956), the University of Kwa Zulu-Natal (formerly the University of Natal) and the University of the Western Cape (1959), the University of the Free State (1969) and the Sefako Magkatho University (previously the Medical University of Southern Africa (MEDUNSA) (1976).The first black medical doctor in South Africa qualified in Scotland in 1883 (Mayosi, 2015). The trend for mixed race South Africans to train as doctors overseas continued until the outbreak of the Second World War when this practice was curtailed. This led to there being a necessity for them to be trained in South Africa resulting in WITS and UCT admitting black medical students in 1941 and 1943, respectively (Digby, 2013). However, with the advent of an apartheid government in 1948 only those of mixed race who had a permit could train at those institutions and in the Natal Province the University had a separate medical faculty for students of colour that was established in 1951 (Digby, 2013). The Medical University of Southern Africa (MEDUNSA) began to admit students of colour for a medical degree in 1977 or a PT degree in 1979. Gender inequality was also a problem in South Africa whereby in 1960 only 10 percent of qualifying doctors were female and of these fewer were black women (Digby, 2013). In 1994 demographic statistics from

UCT showed that by 1994, after the end of apartheid, black African students comprised 24% of those admitted to the medical programme, and of these 30,4% were women (Colburn Kent and Leon, 1995). Since that time there has been a progressive increase in the number of medical students of colour and female students throughout the entire South African University system. With regards to changes in the demographics of the South African PT student population students of colour are now in the majority and an increased number of male students are being admitted although female students are still in the majority.

The dictates of society at the beginning of the new millennium saw first world prosperous nations grappling with the health care needs of an elderly population and a health care system exhibiting spiralling costs (Weatherall, 2000). Technological advances in health care together with the increased pace of service delivery expected from health care professionals have led to the public perceiving them as out of reach and unsympathetic (Weatherall, 2000). In order to address this situation most countries decided to revise their medical education in order to produce more patient orientated medical care (Weatherall, 2000). The final product of a professional and clinically orientated practitioner with the necessary anatomical skills is what early anatomical education should envisage (Moxham et al., 2014; Pawlina, 2006; Swick, 2006).

New aspects of curricular change for anatomical programmes have been investigated (Drake, McBride and Pawlina, 2014). With respect to aspects of curricular change Bolender et al. (2013) caution those who are undertaking integration changes of medical curricula to proceed with caution as each alteration can lead to losses or gains in the production of a new format. The elements of change to anatomy curricula and the resultant effects of this on PT student performance and clinical competency will be considered further.

2.1.2 Defining an Anatomy Curriculum and its Relevance for Clinical Practice

An anatomy curriculum has to be fit for purpose in order to deliver the necessary foundation for the clinical years of practice. Therefore, it has to have relevance for clinical practice. In order for gross anatomy to be taught to PT students in an optimal way it is important that the curriculum is appropriate for their specific needs. Systematic curriculum development addresses who will be taught; what the content will be; how it will be taught (type of pedagogy) and the interaction between subject matter (Kleibard, 1989). A curriculum is a programme where there is planned interaction between the students, instructional materials, resources and processes to

fulfil educational objectives (Adams and Adams, 2003). Gross anatomy course designs have to consider clinically relevant integrated systems and a learning outcomes- based approach in the development of a course curriculum (Stabile, 2015). Programmes in old-style anatomy give much detail but content relevance is not always understood. Therefore, it becomes necessary for a reinvention to take place in anatomy that is directed towards functional and clinical relevancy (Obeidat, 2013).

The variations encompassed within diagnostic procedures and treatment modalities make it extremely important for an anatomy curriculum to take into consideration the opinions of relevant students, anatomy lecturers and clinicians to ensure that the anatomy education will be best suited for safe clinical practice (Sbayah et al., 2016). In this regard clinicians have seen that appropriate anatomy education to ensure student readiness and effectiveness for the clinical road ahead is an important challenge (Sbayeh et al., 2016). It is proposed by some authors that the anatomical knowledge and perceptions of the patient or potential patient regarding the importance of gross anatomy in the medical curriculum should be considered (Moxham et al., 2016). In this regard, patients are becoming more clinically knowledgeable and more demanding as consumers of medical treatment. Treatment has to be geared to putting the ‘patient consumers’ at the top of the process. Hence, the importance of the adequate implementation of sound gross anatomy principles in the medical curriculum should not be overlooked (Moxham et al., 2016).
It has also been identified that the decrease in medically qualified anatomy teachers might result in the poor transmission of the clinical perspective in anatomy education (Bergman, van der Vleuten, Scherpbier, 2011).

With regards to the clinical relevancy of an anatomy curriculum Ahern (2015) emphasised the importance of applied and relevant clinical anatomical knowledge being taught to medical students in Australia because, as an examiner of accredited medical registrars, he became concerned by the poor anatomical knowledge of the candidates. Estai and Bunt (2016) highlighted the dangers of incompetency of surgeons due to inadequate anatomical knowledge and Sbayeh et al. (2016) looked specifically at the relevance of anatomy for a medical clinical role. The latter researchers surveyed anatomy instructors, medical practitioners and medical students to garner their perspective of the subject. The study looked at current curricular trends and pedagogy to evaluate efficacy of anatomy curricula for modern medical practice. The opinions differed between the three groups of respondents and the outcomes identified challenges in formulating a targeted anatomy curriculum that

developed professionalism and raised student preparedness. Yammine (2014) also expressed concern regarding the decline in medical competency and was a strong proponent of using surface anatomy as a way of improving physical examination in the clinical years. In all four afore-mentioned studies the importance of the incorporation of clinically based anatomy was not questioned.

But how, when and by whom should the clinical element of the anatomy programme be incorporated? It was suggested that the clinical application of anatomical knowledge should begin early in the programme to give students insight into its relevancy for future clinical practice (McHanwell, 2015: 358). This researcher also put forward that there should be a progressive integration of clinical facts into the programme with more complex clinical information being introduced later. Sbayeh et al. (2016) found that clinicians felt that clinical teaching should be more closely associated with the learning of anatomy. These authors suggested that anatomy should be vertically integrated into the later clinical years but Malik and Malik (2011) put forward that vertical integration throughout the entire curriculum would help students implement a holistic approach to patient teatment. The argument for and against integration of clinical input from the beginning of the anatomy programme was made by Bolender et al. (2013) who asked the question as to whether students would be able to integrate clinical knowledge with only a rudimenatary understanding of human anatomy. It was established by these authors that integration strategies are complicated and that curricular goals have to be clearly defined.

Ahern (2015) also alluded to the lack of medically trained anatomy staff that could instruct non-medical staff in clinical matters in Australia. He felt the situation to be unacceptable. Furthermore, he felt that useless non-clinical information should be disregarded so a focus could be placed on relevant clinical facts. With regards to PT student anatomy education a number of authors have suggested that a gross anatomy curriculum for PT students should incorporate input from physiotherapists, be taught by physiotherapists (Reimer, Laurenzano and Tages, 2013; Latman and Lanier, 2201; Armstrong and Rosser, 1996; Mattingly and Barnes, 1994) and be clinically relevant to PT practice (Moxham et al., 2014; Johnson, Charchanti and Troupis, 2012; Latman and Larnier, 2001). Hence, this ties in with the idea that those persons most suited to teaching anatomy to undergraduate PT students may be PT clinicians well versed in anatomy as they can offer a clinical perspective to the anatomical information and therefore emphasise the appropriateness of learning anatomy for safe future clinical practice. The different types of PT degree programmes offered worldwide are designed to accommodate the needs that pertain

to the specific PT practice in each of those countries. This means that anatomy curricular design for a particular student population has to be appropriate for the needs of the clinical PT practitioner as per the requirements of the controlling allied medical board in that country and the relevant needs of the patients in that country (WCPT, 2015). As pointed out by Drake, McBride and Pawlina (2014) the requirements of the student body to be taught by a particular institution has to be factored in when a curriculum for an anatomy programme is being considered. Members of the Carnegie Foundation tasked with looking at the reform of USA medical education in 2010 also suggested that students should be allowed to pursue their studies in an individualised way and progress when competency is achieved.

2.1.2.1 **Systemic versus the regional anatomical approach in a curriculum**

The positioning of gross anatomy in a medical curriculum has long been debated. Together with a certain amount of controversy regarding pedagogical inclusions, time allocated to gross anatomy and clinical relevance of the formation of an anatomy curriculum has resulted in many challenges (Moxham and Pais, 2016). One of the main challenges identified is whether the approach to anatomy education should be a systemic approach or a regional approach (Moxham and Pais, 2016). It is argued by these authors that the systemic approach classifying the organs and tissues into wide categories such as the musculoskeletal system, the respiratory system and neurological system among others fits well with the integrated medical curriculum (Pais and Moxham, 2013). Contrarily the regional approach looks at structures in the major regions of the body such as the head and neck, thorax and perineum (Pais and Moxham, 2013). In a 1996 survey of American and Canadian PT gross anatomy programme researchers found that the vast majority of the American programmes (97%) favoured a regional approach and this was only found in 36% of Canadian programmes (Armstrong and Rosser, 1996). Only one of the American programmes favoured a mixed approach but in Canada this was the case in 46% of the programmes. Furthermore, the Canadians used a systemic approach in 18% of programmes while no American programme used this approach. The systems-based approach to anatomy learning incorporated in the problem based learning model does not gel well with dissection and this may be why 58% of the Canadian programmes used prosection. Anatomists at Morehouse School of Medicine in the USA resolved the problem by mixing regional dissection with an integrated systems-based approach to the teaching of body structure and function (Paulsen, Klement and Wineski, 2015). They qualified their decisions on adaptation of the curriculum on the fact that students are highly satisfied and are achieving higher grades with the new curricular format. If an anatomy programme is following a regional approach it may be

challenging to integrate it with the more systems-based clinical courses (Bolender et al., 2013). While a systems-based anatomy programme reportedly resulted in deeper understanding and better retention of anatomical knowledge the implementation of the change to facilitate integration with clinical modules presented some challenges (Hagen et al., 2017). These were mainly regarding the curricular content and scheduling of the interactions between the anatomy department and the various clinical departments. The integrative curriculum and systemic approach can be combined with elective regional anatomy courses that allow students to experience the regional format and possibly cadaveric dissection in an optional format (Moxham and Pais, 2016).

2.1.2.2 **Anatomy 'core' curriculum**

The formulation of a 'core' curriculum for anatomy predisposes that the elements that constitute the 'core' material can be identified and defined (Moxham et al., 2014). This thesis has already identified aspects of anatomical education that have to be considered for inclusion in a anatomy curriculum (point 2.1.2) that meets the needs of modern medical and allied professions student bodies.

An earlier move towards establishing parity in the USA and Canada was instituted in 1996 when the Educational Affairs Committee of the American Association of Clinical Anatomists (AACA) developed a document that defined the guidelines for anatomical concepts and the level of mastery of anatomical subject matter that medical students should achieve before they graduate from medical school. The AACA also endeavoured to standardise the requirements for a fundamental degree of competence across all medical faculties (Leonard, 1996). A survey of how gross anatomy was being taught in bachelor degree and entry-level master of physical therapy (MPT) degree programmes was carried out in Canada and the USA in order to compare the gross anatomy teaching programmes and to endeavour to improve the courses in each country (Armstrong and Rosser, 1996).

Due to the fact that consensus about a common curriculum is often lacking in medical education there has been a resultant autonomous creation of curricula in institutions without adequate validation or correction (Turney, 2007). The idea of a core curriculum for anatomy has been mooted for a number of years with the aim of trying to establish some degree of uniformity within the teaching of undergraduate (entry-level) medical and/or allied health science students gross anatomy programmes. In the United Arab Emirates it has been suggested by Yammine (2014) that a national

core curriculum should be implemented by local societies involved in medical education.

In the UK the Anatomical Society developed a medical core syllabus for anatomy in 2003 and this was refined in 2007 (Smith et al., 2016). In the case where a core curriculum was not available Bergman, van der Vleuten and Scherpbier (2011) reported that the literature showed that time constraints had led to the anatomy curriculum being cut down to the detriment of the inclusion of material with vocational clinical relevancy. In order to provide adequate core anatomical information for undergraduate medical students the University of Edinburgh adopted a self-directed approach with a number of resources being used in tandem with a resultant significant improvement in anatomy assessment scores (Findlater et al., 2012). An effort to try and develop a core curriculum incorporating internationally recognized standards in anatomy education for medical and allied health professions students with an emphasis on clinical relevance was begun in 2014 using a Delphi model (Moxham et al., 2014). The aim of such a survey is the development of a global anatomy core curriculum that can be incorporated into anatomy programmes worldwide. Smith et al. (2016) decided to conduct a study using a modified Delphi technique to collect a wider perspective on the topic of expected learning outcomes for an anatomy programme for medical students than that originally reached in 2003.

Pertinent to this thesis in gross anatomy education for PT students Mattingly and Barnes (1994) conducted a survey in which 145 US PT institutions were approached in order to establish how gross anatomy was being taught to the PT undergraduate student population at that time. Although the main aim of that study was not to establish a core curriculum for PT students in the USA the information gleaned in the survey allowed the researchers to draw conclusions about ideas for a possible core curriculum. A later survey in the USA, although again not specifically seeking to establish a core curriculum for PT students, sought the opinions of clinical physiotherapists among other allied health professionals as to their recommendations for a gross anatomy course (Latman and Lanier, 2001). These researchers concluded that the gross anatomy curriculum should address the future clinical requirements of the profession it was designed to teach. In 2013 Reimer, Laurenzano and Tages conducted a survey of institutions offering gross anatomy to PT students in the USA and compared the results to those found by Mattingly and Barnes in 1994. These researchers found computer-assisted learning was being incorporated in more anatomy programmes in 2013 than in 1994.

2.1.3 Development of an Anatomy Curriculum, Factors that Influence Curricular Inclusions and the Implications for Safe Clinical Practice

Many factors have to be taken into consideration when an anatomy curriculum is being drawn up. The decrease in available hours for the teaching of anatomy has to be considered in the context of providing students with adequate, satisfactory and pertinent knowledge that will equip them for safe future clinical practice. Recommended changes to curriculum styles have to be considered. The number of suitably qualified staff available may be directly linked to any financial constraints being experienced by the faculty and cash flow will also have a bearing on teaching resources such as the procurement and storage of human cadavers for dissection. Ethical and professional guidance for students must also be considered in order to produce empathetic and socially conscience health care professionals. These factors and others will be elaborated on in the following sections.

2.1.3.1 Recommended changes in curriculum style

In 1996 members of the Educational Affairs Committee of the American Association of Clinical Anatomists (AACA) drew up a document that suggested guidelines for an anatomy curriculum that could be implemented in US medical schools for 21st Century medical students (AACA, 1996). It includes a comprehensive method to link gross anatomy learning with clinical application. The hierarchy of anatomical concepts is represented in a pyramid form (Figure 2.1) and clearly shows that the end goal of anatomical education should be assimilation with clinical anatomy. The learning of anatomical terminology is an essential part of the path to understanding anatomy. Very few students today learn Latin or Greek as part of their scholarly journey and when they begin their gross anatomy programme are introduced to an entirely new terminology for the structures they are learning. Shanahan (2001) points to the fact that the understanding of the meaning of anatomical terms will serve the student better in the quest to retain information than undertaking rote learning.

The traditional way to address the matter of three-dimensional (3D) learning in gross anatomy is through dissection (Kramer and Soley, 2002). In 1992 Lee and Allison performed a randomised controlled trial (RCT) to ascertain whether interactive computer assisted learning (ICAL) could be used to turn the two-dimensional (2D) theory of anatomy into a 3D ICAL package and reported the same level of academic achievement with the new methodology as had been seen with the traditional teaching. Furthermore, in a unique South African study Gangata (2008) used a Muscle Cut Out Exercise (MCOE) where 2D diagrams of certain muscles were drawn, cut out and pasted on skeletons to create a 3D learning effect. Functional

anatomy, in line with the model depicted in Figure 2.1, would be an important inclusion in a PT gross anatomy programme (Youdas, Krause and Hellyer, 2015).

Barco (2010) mentions shortage of time and large class sizes as a factor in the consideration of how surface/living anatomy has been taught during the last ten years in the USA. A solution was found by using digital resources and subsequent self-palpation of upper limb structures. Nanjundaiah and Chowdapurkar (2012) used body painting as a method of learning surface/living anatomy and recorded a positive response by PT students. Results obtained through the national gross anatomy survey used to collect data in Study 2 (Paper 3) of this thesis adds insight into how surface /living anatomy is perceived in South Africa. This information is presented in Chapter 4 of this thesis.

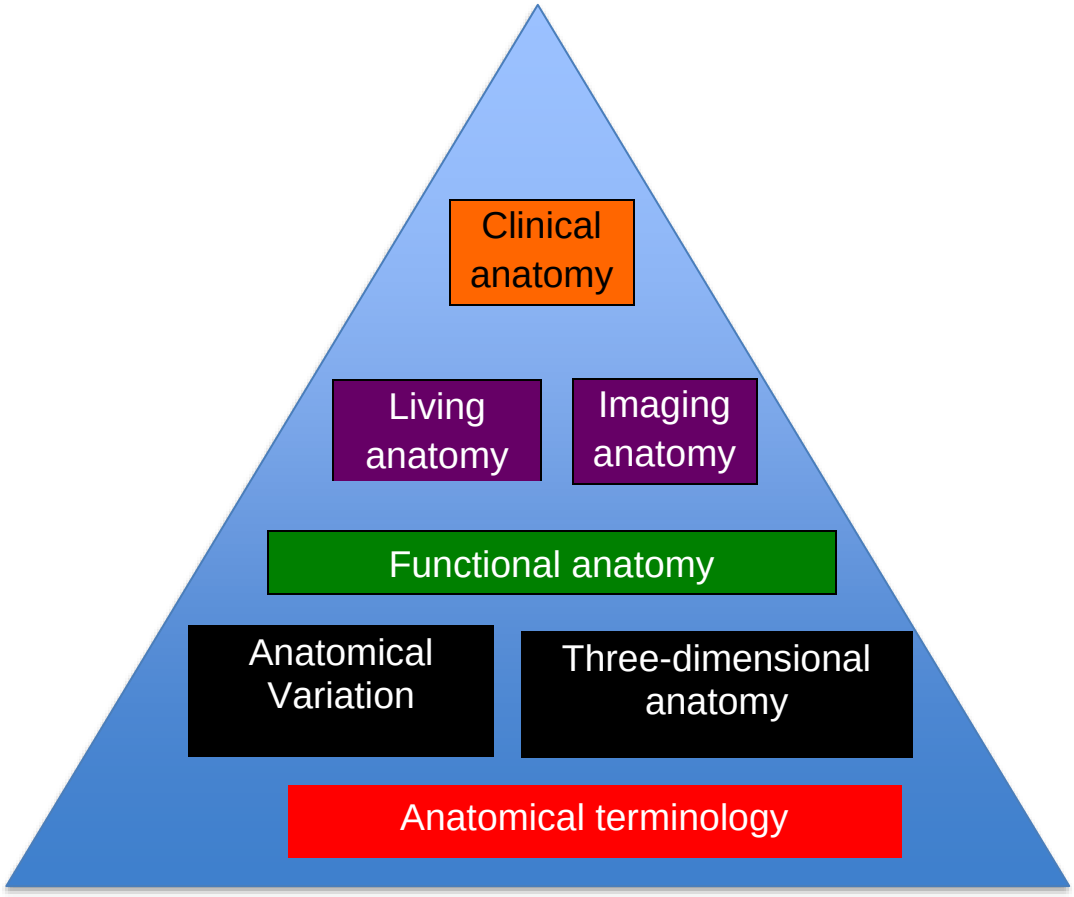


Figure 2.1: **Hierarchy of Anatomical Concepts that Link Gross Anatomy Curriculum to Clinical Application** (*reproduced from AACA Figure 1, 1996*)

In order to achieve the clinical anatomy goal at the top of the hierarchy pyramid horizontal and/or vertical integration of clinically relevant information is essential. Such knowledge can be imparted to a specific student group by clinicians from that profession who are also well versed in anatomy. Wisco et al. (2015) reported on the incorporation of clinical personnel to teach anatomy leading to inter-professional

integration. Latman and Larnier (2001) concluded that a gross anatomy course should incorporate the clinical knowledge pertinent to the professional healthcare discipline of the students. In this respect, Reimer, Laurenzano and Tages (2013) found that there was a decrease in the number of PT qualified persons teaching anatomy to PT students in the USA compared to the number reported by Mattingly and Barnes in a 1994 survey.

2.1.3.2 **Time constraints in anatomy teaching**

Medical school curricula in the early 1940's had gross anatomy courses that rated as the most important of the basic science courses due to the number of teaching hours allocated to them (Dawson, 1988). Doctors' views on the relevance of anatomy in comparison to other medical subjects found anatomy to be of fundamental importance (Pabst and Rothkötter, 1997) and students at medical schools in Wales and France also rated anatomy as a very important component of their medical training (Moxham and Plaisant, 2007). Undergraduate PT students in Spain found the inclusion of gross anatomy in a PT course 'highly appropriate' (de Oliveira et al., 2015). In recent times the teaching of human anatomy, in the global arena, is reported to be influenced by less available instructional time (Drake, McBride and Pawlina, 2014; Drake et al., 2009; Lockwood and Roberts, 2007). In this respect there is consensus about the decrease in time allocated for anatomy education across the USA, the UK, Asia, Europe, Africa and Australasia (Azer and Eizenberg, 2007; Plaisant, Cabanis and Delmas, 2004; Drake, Lowrie and Prewitt, 2002; Heylings, 2002, Kramer and Soley, 2002; Cottam, 1999; Leong, 1999).

Before the mid 1940s gross anatomy course time was around 500 hours (Hildebrandt, 2010; McCotter, 1947 in Hildebrandt, 2010). Peterson and Tucker (2005) reported that, in the State of California in the USA, the medical anatomy course had been decreased in length from 172 hours in1999-2000 to 135 hours in 2001-2002. At this time the reduction in hours was mainly attributed to a cutting down in time spent in lectures with time devoted to dissection largely being maintained. By 2002 the USA national average for the total number of gross anatomy course hours for medical students was 167 and by 2009 this had further decreased to a national average of 147 hours (Drake et al., 2009; Drake, Lowrie and Prewitt, 2002). In this regard Kramer and Soley (2002) reported on the decrease in the time available for the teaching of anatomy to medical students at WITS in South Africa and suggested ways to identify and address topics that the students found problematic in order to utilise the available time maximally.

A 2015 study has looked at the feasibility of anatomical competency, albeit at a foundational level, being achieved in a 105 hours course lasting for six and a half weeks (Halliday et al., 2015). The authors pointed out that there was a good assessment rating achieved in both years that the compressed course was offered. However, they reported that they had a few initial problems with the implementation of such a shortened course. In a longitudinal cohort study conducted in the USA between 2010 and 2015 it was found that the level of medical students' retention of anatomy increased over the first two years of their medical degree and remained at a 90% level over the final two years. This study was conducted where the gross anatomy component was reduced to approximately 60 hours. The researchers concluded that the use of cadaver demonstrations, considerable use of imaging, relevant active learning methods and continuous reinforcement of information were the reasons for the successful outcomes (McBride and Drake, 2016).

Recently, Pawlina and Drake (2017) reported that the fundamental content of an anatomy course for medical students has not changed over the years but students are expected to learn it in a shorter time frame. In this regard an average of 76% of third, fourth and fifth year students in Saudi Arabia identified anatomy as having too much content for the available course time and the author identified this factor as one that contributed to increasingly negative opinion of basic sciences like anatomy by such medical students (Alam, 2011). However, contrarily McBride and Drake (2016) found the decrease in time had not impacted adversely on medical students' understanding and retention of fundamental anatomical concepts. These opposing views may be explained by the fact that issues such as the structure of the curriculum and pedagogy used to teach it might be influential in dealing with the time constraints more effectively and this is considered later in this thesis.

2.1.3.3 **Decline in clinical standards associated with decreased anatomy hours**

Since the beginning of the 21st century gross anatomy course time constraints have influenced a decline in the standard of anatomical teaching outcomes internationally. In this regard Papa and Vaccarezza (2013) and Sugand, Abrahams and Khurana (2010) reviewed studies that looked at how the anatomical time constraints resulted in a decrease in medical students' anatomical knowledge with resultant decreased clinical competency and an increase in the concern for the safety of patients treated by such clinicians. Similarly, other researchers noted that the changes associated with anatomical education might impact on patient safety (Yammine, 2014; Darda, 2010; Bergman et al., 2008; Turney, 2007).

It was reported that between 1995 and 2000 there was a seven-fold increase in claims associated with anatomical mistakes reported to the Medical Defence Union in the UK and a third of these were associated with general and vascular surgery (Turney, 2007; Ellis, 2002). Boon et al. (2001) at the University of Pretoria in South Africa found that when clinically relevant content is integrated into the anatomy programme it facilitates the understanding of anatomy and results in better clinical thinking. It is important to bear in mind that the satisfactory learning of topographical anatomy has been reported to be a key basis for the safe and effective practice of medicine (McHanwell et al., 2007). Half of newly qualified doctors at a medical school in the UK believed that the anatomy teaching they underwent was insufficient in relation to their career development and academic performance in an anatomy course based in dissection and prosection (Fitzgerald et al., 2008). Many of these respondents also felt that anatomy teaching should be vertically integrated throughout their time at medical school. Vertical integration studies where PT students performed clinical tests on joints reported better understanding of anatomy by the students (Krause, Youdas and Hollman, 2011; Parmar and Rathinam, 2011).

In 2014 the Australian Medical students' Association debated the amount of time that should be spent in anatomy to ensure safe clinical competency (Farey, Sandeford and Evans-McKendry, 2014). In order to address this question it has been suggested that the link between clinical content and case-based examples should be incorporated into anatomy programmes. It is feasible to presume that some change might occur in the standard of clinical practice associated with newly qualified physiotherapists as has been seen with doctors. In the case of PT gross anatomy education there is evidence that in 1994 the traditional format for teaching anatomy to PT students was used and was similar to that taught to medical students (Drake et al., 2009; Mattingly and Barnes, 1994). Decrease in dissection with an increase in computer assisted learning seen in more recent PT gross anatomy programmes (Reimer, Laurenzano and Tages, 2013) mirrors the changes seen in medical programmes (Tam et al., 2010; Turney, 2007). Definitive documentation of the specific impact of time constraints on PT students' anatomy learning have not been documented.

2.1.3.4 Reduced numbers of suitably qualified staff and financial constraints

Other factors identified as influencing availability of instructional time are financial constraints and fewer suitably qualified anatomy teachers (Gabard, Lowe and Chang, 2012; Thomas, Denham and Dinolfo, 2011; Wilson et al, 2011). The term suitably qualified staff has also been used to define whether the staff teaching anatomy are

suitably medically qualified in order to have insight into the reasoning behind why the subject is taught and its clinical relevance (Bergman, van der Vleuten and Scherpbier, 2011). This perspective could possibly also be extrapolated to the teaching of gross anatomy to PT students where it could be preferable for the anatomy instructors to be qualified physiotherapists who can place the gross anatomy teaching into the context of clinical relevancy.

The decrease in the number of suitably qualified staff has impacted on staff to student teaching ratio. It was reported that in Scotland there had been a decrease in lecturer to medical student ratios from 1:20 between 1983 and 1984 to 1:58 between 2003 and 2004 (Bergman, van der Vleuten and Scherpbier, 2011; Pryde and Black, 2005). The authors suggested that this showed a trend towards fewer staff being available to teach the students. However, in the UK a survey by Heylings (2002) found average staff to medical student ratios in dissection of 1:19.8 and in practical sessions 1: 20.2. In the USA a current shortage of suitably qualified staff was reported by a group of authors who stipulated that they felt that this was a temporary situation and that sufficient staff was being sourced and trained to take on the mantle of future gross anatomy education for health professional students (McCuskey, Carmichael and Kirch, 2005). An international literature search of articles written between 1950 and 2007 carried out by Bergman, van der Vleuten and Scherpbier (2011) reported that the student to staff ratio had doubled in some institutions. On the African continent Kramer, Pather and Ihunwo, (2008) found that staff to medical student ratios were acceptable. These ranged from 1:15 to 1:35 in Egypt, 1:15 to over 1:35 in Nigeria, Uganda and South Africa, 1:25 in Malawi and Mozambique and 1:30 in Zambia. This was considered a positive discovery, by these researchers, in relation to anatomical teaching on the African continent. Kemeir (2012) found in a Saudi Arabian study that staff to medical student ratios of 1:21 was not favourable to the use of teamwork during anatomy sessions. In a Tanzanian study the researchers suggested reciprocal peer teaching as a possible solution to address a poor staff to student ratio of 1:38 (Manyama et al., 2016). Recently Green and Whitburn (2016), in Australia, have documented anatomy staff to undergraduate PT student ratios of 1:25 in anatomy practical sessions. However, no definitive reference to optimal staff to PT student ratios for anatomy education was sourced.

In general, universities in the first world countries are well funded. However, reports from medical schools in the USA and Canada in 2010 after the major world-wide downturn in the economy stated that, although the economic problems had presented challenges to the maintenance of medical educational programmes, there had been a

concerted effort made to protect and strengthen such programmes (Anderson and Kanter, 2010). The hardship led to centralisation of resources with resultant better efficiency. Medical schools became innovative in the way they distributed funds in order to support research and the educational programme. However, a review of international literature reported that financial constraints had impacted on the use of cadaveric material for dissection (Bergman, van der Vleuten and Scherpbier, 2011).

Contrarily to the norm in the first world countries previously mentioned in Ghana when a PBL curriculum was implemented for medical students the fact that students were assigned to small groups of between 6 and 10 meant that the allocation of faculty staff facilitators was increased and this placed an added burden on already stretched finances (Amoako-Sakyi and Amonoo-Kuofi, 2015). Further apparent financial considerations were that the facilities to accommodate student tutorials would also have to be expanded and this was expensive. Hence, in medical schools where resources are poorly funded the implementation of problem–based learning presents different challenges to those that are present in first world scenarios.

2.1.3.5 Cadaver availability and religious and cultural acceptability of cadaver procurement

Another consideration that has to be made in regard to inclusion of certain pedagogies in the gross anatomy curriculum is the availability of cadavers for dissection or prosection purposes. Furthermore, the difficulties arising from the practical management of cadavers and the religious and cultural beliefs of some students are creating challenges pertaining to the use of cadavers in anatomical education (McKenzie and Gutierrez, 2007). Gangata et al. (2010) report that in the USA 80% of cadavers are donated and in the UK all cadavers are donated. With regard to the availability of cadavers in Africa, Gangata et al. (2010) reported that 80% of cadavers used for dissection in South Africa and Zimbabwe are donated and that 90% of the surveyed medical schools use cadavers for dissection. In many of the African countries the lack of awareness of the possibility of donating one's body together with religious and cultural burial traditions results in a low number of cadaver being bequeathed. However, in this regard in 2012 a Nigerian study found that 86.6% and 91.7% of first year medical students respectively found human dissection religiously and culturally acceptable (Oyeyipo and Falana, 2012). Gangata et al. (2010) also found that impoverishment due to low socio-economic standards, the criminal population and homelessness often led to unclaimed bodies being used as cadavers for dissection in some African medical schools.

2.1.3.6 **Ethical and professional aspects of a curriculum**

A gross anatomy curriculum for PT students should help to instill in such individuals an ethical and professional attitude to the conduction of their clinical duties. In order to give Doctor of physiotherapy (DPT) students a more humanistic insight into their interaction with cadavers during their gross anatomy dissection a special lecture was delivered prior to the commencement of the programme. To assess the behavioral and humanistic parameters felt by the students after their gross anatomy dissection experience they were asked to express their feelings in prose, poetry, music, art or video (Canby and Bush, 2010). It appears that an overall positive response was achieved and beneficial effects in the areas of professional and humanistic growth and reflective learning were recorded. A study of DPT students looked at how the students who took part in dissections were performing in relation to ten professional PT behaviours. Students reacted positively to the intervention and may have been more inclined to perform in a professional way due to peer competition and pressure (Youdas et al., 2013). Kawashiro et al. (2009) looking at whether exposure to prosected cadavers in a laboratory setting influenced PT students' beliefs about the dignity and value of human life saw a significant increase in scores post intervention. McKenzie and Guterrez (2007) replicated this finding and found that first year DPT students had a very positive response regarding respect for human life after observing prosected cadavers. Furthermore, in the same study second year DPT students similarly rated dissection of cadavers highly in relation to learning about respect for human life.

2.1.3.7 **Relevance and retention of anatomical information for clinical practice**

When considering the gross anatomy student's retention of anatomical detail there are numerous factors to consider. In the case of first year medical students the course load, decreased time for dissection and increased need for self-study influenced the student's ability to comprehend and retain the anatomical information (Granger and Calleson, 2007). In 2005, Vasan and De Fouw reported that at the New Jersey medical school in the USA team learning had been introduced. This method of teaching gross anatomy promoted interactive and active learning in small groups of eight students. It encouraged the students to prepare the weekly material and in so doing increase their anatomical knowledge and depth of learning. It also allowed for the insertion of clinical information.

Pawlina and Drake (2016, 2017) found that the method of teaching anatomy to medical students had to be linked to the relevance for retrieval, application and retention of the subject for application in clinical practice.

Physiotherapy is a clinical profession where professionals aim to maximize clients' ability to move and function when clients have been affected by ageing, physical injury, diseases and disorders (WCPT, 2016). A high standard of gross anatomy knowledge is thus vital for these professionals to enable them to evaluate normal movement effectively and identify abnormality. A gross anatomy curriculum for undergraduate PT students should thus be clinically relevant to PT practice (Johnson, Charchanti and Troupis, 2012; Moxham et al., 2014). It should also be taught in a manner that helps the PT students retrieve, apply and remember anatomical content to enable best clinical practice. In this regard a team-based learning intervention reported retention for anatomical information one or two years post anatomy programme (Huitt, Killins and Brooks, 2015). Furthermore, survey respondents reported that dissection was beneficial to the understanding and retention of anatomy but anatomy teaching videos, using computer assisted learning, resulted in longer retention of anatomical information (Khan et al., 2015).

2.1.4 Descriptions of and Considerations for the Choice of Pedagogies to Teach an Anatomy Curriculum

Pedagogy relates to the activities of educating and the teaching methods employed to do so. In anatomy programmes it is usual for various combinations of pedagogies to be incorporated into the way in which the gross anatomy curriculum is delivered to the student body. A survey was undertaken in 2012 to assess current instructional techniques and factors influencing them and the projected 2020 anatomy instructional techniques and the factors that may influence them (Gabard, Lowe and Chang, 2012). The participants were anatomy instructors from the medical and PT fraternities. These instructors were further sub-categorised into general and expert instructors. The results for this survey looked at the present average time spent by students on total body dissection, living/surface anatomy and imaging and compared that with the 2020 average time spent by students' projections for each of these teaching methods. A recent critical review of the literature looking at the way in which anatomy education is conducted gives a succinct and detailed insight into various anatomy pedagogies that can be used to teach the subject for beneficial outcomes (Estai and Bunt, 2016). The next sections describe the various pedagogies that can be incorporated into a gross anatomy programme.

2.1.4.1 The use of cadaveric dissection and/or prosection

Historically, the necessity of cadaver dissection to learn medical gross anatomy has long been debated (Guttmann, Drake and Trelease, 2004). Granger (2004) and Pawlina and Lachman (2004) supported dissection and said that it was a vital

component as it offered students the chance to see anatomical variability in cadavers and perceive the body as a human subject. Topp (2004) argued that the prosection format also allows students to see anatomical variability. Aziz et al. (2002) raised the argument that using cadaveric dissection was expensive, consumed too much time and was old fashioned. This was supported by the alternative view that prosections are time-efficient, flexible, allow for easy recognition of anatomical structures and associated relations, can be viewed in context and fewer cadavers need to be used as different groups of students can observe the same material at different times (Pather, 2015). Furthermore, the problem-based learning moved from a regional-based approach to anatomy to a systems-based approach, the desire to avoid breathing in formalin fumes, cost related constraints and medico-legal and ethical matters has influenced the move from dissection to prosection according to some researchers (McMenamin et al., 2014; Sugend, Abrahams and Kurana, 2010). However, Torres et al. (2014) concluded that cadaveric dissection is still the most popular method of teaching gross anatomy and Bergman (2015) reported that studying and understanding the 3D relationships of structures is best done in the dissection room, at least until 3D software and glasses become mainstream. Many medical students also seem to think that for a deep anatomical understanding and interesting way to learn anatomy dissection is essential (Alhassan and Majeed, 2018; Dissabandara et al., 2015; Böckers et al., 2010).

It appears from information documented in the literature that the use of prosected cadavers or dissection of cadavers may be almost equally weighted as far as being considered valuable in the teaching of gross anatomy. The following examples that embrace either or both forms of pedagogy attest to this fact. In Australian and New Zealand medical schools where an integrated, case-based systemic learning curriculum is in place most programmes support the use of prosection (Craig et al., 2010). In Ireland 65% of surveyed surgeons felt that cadaver prosection was the most beneficial method of teaching gross anatomy and should be retained in anatomical education (Sheikh et al., 2016). And yet, in a recent survey of Venezuelan surgeons, 89% of the respondents rated human cadaveric dissection as important despite the advent of newer innovations in anatomy teaching (Romero-Reverón, 2017). In 2002, Kramer and Soley, in a study looking at what South African medical students reported as problematic topics in their anatomy course, found that 97,5% of respondents identified problems with 3D visualisation and 78.5% advocated for more visual aids including dissections to be used as a possible solution to that problem. Kramer, Pather and Ihunwo (2008) found that dissection was being used successfully, in the teaching of anatomy to medical students, throughout the African continent. Rennie,

Naidu and Van Wyk (2011), of the University of Kwa-Zulu Natal in South Africa, surveyed second year medical students to assess their perceptions of learning anatomy by the use of dissection alone. The students offered positive feedback with regard to the understanding of anatomy in more depth. Hence the researchers concluded that, in the quest to improve the standard of medical clinicians, traditional anatomy pedagogy should not be overlooked in favour of only using newer teaching methods. This sentiment was also expressed in studies by Dissabandara et al. (2015) in Australia and by Alhassan and Majeed (2018) in Ghana. Interestingly in an early survey of Canadian and American gross anatomy programmes for entry level PT students it was found prosection was favoured by Canadian programmes and dissection favoured by American programmes (Armstrong and Rosser, 1996). In a Varied-Integrative-Progressive (VIP) intervention first year DPT students were given gross anatomy instruction using prosected cadavers and second year DPT students dissected. A very positive response to the learning and retention of the subject in both years of student study was recorded (McKenzie and Gutierrez, 2007). In the afore-mentioned study by Gabard, Lowe and Chang (2012) the average percentage time spent in total body dissection was 60%-73% over all four categories but the projected 2020 results predicted a decrease in the use of dissection.

Kermanian, Farajidana and Motaharipour (2018) reported that cadaveric dissection is important as the basis of the development of the medical professional ethic. Similarly, Youdas et al., (2013) in a study of DPT students undertaking dissection in their gross anatomy programme found that ten professional PT behaviours were enhanced by a brief intervention during the course that involved positive reinforcement of good professional behaviour by students. The ten professional behaviours that were being assessed in this study were: ‘Critical thinking; communication; problem solving; interpersonal skills; responsibility; professionalism; use of constructive feedback; effective use of time and resources; stress management and commitment to learning.’

One aspect of learning gross anatomy using cadaveric material is the psychological impact that such an activity can have on the PT student. Anticipatory anxiety pre-cadaveric observation was measured and then after two prosection sessions and at the end of 18 months post exposure the students completed the Impact of Event Scale that measured the short-term effects of their exposure to the cadaveric material. The researchers found that female students seemed more sensitive to the cadaveric experience. However, there was a decrease in the percentage of students exhibiting a significant stress level at the 18-month follow up (Hancock et al., 1998).

Bernhardt, Rothkötter and Kasten (2012) mirrored Hancock et al 1998's earlier finding that students' emotional concerns prior to the introduction to the cadaver reverted to an unstressed state later in the programme. These researchers also found that female students were more susceptible to stress in such a situation.

2.1.4.2 Relevancy of other pedagogies in the teaching of anatomy and pedagogical combinations

The inclusion of dissection in some instances has been retired completely in favour of modern technological applications such as interactive multimedia and imaging concepts (Sugand, Abrahams and Khurana, 2010). In some instances clinical videos are used to enhance anatomical teaching (Prados et al., 2007).

Taking into consideration the afore-mentioned changes newer types of teaching methods have been proposed or introduced and have already begun to influence the type of gross anatomy pedagogy and curriculum available to PT students.

2.1.4.3 Computer assisted learning

It has been stated that computer technology and simulation techniques can never match the complexities and miraculous creation of the human body (Pawlina and Lachman, 2004). It is also stated that computer assisted learning does not have the incomparable hands on feel of human flesh and it has been described as being artificial and synthetic (Böckers et al., 2010; Hasan, Ageely and Hasan, 2010; Sugand, Abrahams and Kurana, 2010; Azer and Eizenberg, 2007). But other considerations such as time constraints, technological advances, increased costs related to the use of cadavers and larger classes has seen computer assisted learning being considered more frequently for use in teaching anatomy (Tam et al., 2010).

There are studies that promote the view that computer assisted learning can be used alone (Silén et al., 2008; Marks Jr, 2000) although it may not prove to surpass traditional methods (McNulty, Halama and Espiritu, 2004). It might also be used to compliment traditional instruction **(**Stirling and Birt, 2014; Codd and Choudhury, 2011; Sugand, Abrahams and Khurana, 2010; Tam et al., 2010) for PT students as well as medical students.

There are some studies looking at the use of computer assisted learning in PT populations. Plack (2000) conducted a study of MPT degree students over two years. The examination-measured outcomes led the researchers to conclude that the use of

computer assisted learning and prosections was as effective as dissection in teaching gross anatomy. Anderson and Conley (2000) studied 28 PT students who learnt by means of computer assisted learning and models to see how well they retained the anatomical knowledge at the end of the course and at six month and one year intervals after the intervention. They found anatomical detail was retained at each stage tested and computer assisted learning was more cost effective than traditional anatomy education methods. However, on the contrary Turney (2007) reported that the move from cadaver-based anatomy to the use of computers in anatomy might not be beneficial to the understanding and retention of basic anatomical knowledge by medical students.

In a recent development where mobile devices (tablets) were used to introduce a novel anatomy software application to medical students in KwaZulu-Natal in South Africa a positive and beneficial outcome was found in respect to student access to the anatomy programme material (Lazarus, Sookrajh and Satyapal, 2017).

Marks Jr (2000) addressed the role of 3D teaching methodology in medical education and raised many questions as to whether dissection versus no dissection affects a student's ability to understand the 3D data about the human body. Kramer and Soley (2002) examined the viewpoints of medical students to ascertain which anatomical concepts were problematical to them. The ability to visualise anatomical structures and understand 3D concepts were found to be the most difficult. With the afore-mentioned two studies in mind Silén et al. (2008) reported that the introduction of advanced 3D visuals in anatomical pedagogy was successful but questioned the students' perception of such visual material. Simulation, as it pertains to anatomy, is the virtual interactive version of an actual gross anatomical system or region. Three-dimensional perception by students can be realised by the use of virtual reality to simulate dissection (Trelease, 2002). Torres et al. (2014), after reviewing 72 articles, concluded that simulation was the second most popular method of teaching gross anatomy. After testing a group of students with no previous knowledge of the musculoskeletal anatomy of the human forearm researchers found that the virtual teaching method complimented the traditional anatomy pedagogy (Codd and Choudhury, 2011). Nowadays there are numerous simulation programmes and tools that can be utilised as a supplementary pedagogy to other gross anatomy teaching methods.

2.1.4.4 **Plastinated specimens and anatomical models**

In 1977, Von Hagens developed the method of plastination to preserve human anatomical specimens (Von Hagens, Tiedemann and Kriz, 1987). Such plastinated

specimens are odourless and can be handled and stored easily (Fruhstorfer et al., 2011; Jones and Whitaker, 2009; Latorre et al., 2007). They also last for approximately ten years and can be stored relatively cheaply (Latorre et al., 2007).

Azu et al. (2012) presented a paper at the 40th Annual Conference of ASSA where they surveyed 280 medical and anatomy students about their opinion on the use of plastinated specimens in the anatomy lab. Seventy five per cent of the respondents indicated that the use of plastinated material was very useful and its use together with cadaveric specimens was proposed by 78% of the respondents. In a combined methodology intervention Both Prados et al. (2007) and Anderson and Conley (2000) used anatomical models as part of multimodal anatomy programmes. Serrat et al. (2014) in a pilot study based in the USA, enhanced the learning of complex anatomical regions by using 3D models that the students were able to source from portable containers at any time in order to facilitate self-study. These researchers reported that average examination scores were increased in certain areas over the period of the study. Hence, both plastinated specimens and anatomical models have a place in the overall arsenal of materials that can be used to assist students in the learning of gross anatomy.

2.1.4.5 **Surface/living anatomy**

This is a superficial or surface identification, palpation, demarcation and perhaps auscultation of certain structures on a human body (Estai and Bunt, 2016). After the initial introduction of recommendations by the General Medical Council in Britain in 1993, a study conducted in Northern Ireland found that the new systems-based course had a negative impact on medical students' results especially with regard to surface anatomy (Mc Keown et al., 2003). As the name suggests living anatomy has the advantage that it is carried out on a living person and therefore is pertinent to a real life clinical scenario. Surface anatomy can be carried out on a cadaver or on a living person. In the case of living anatomy peer physical examination where students physically examine each other and body painting can be used (Estai and Bunt, 2016; Rees, Bradley and Mc Laughlan, 2005). In body painting marker pens and wax crayons are used to paint the position of internal anatomical structures on the surface of the skin (Estai and Bunt, 2016; Mc Menamin, 2008). Coloured non-toxic paints can also be used to carry out body painting as described by Nanjundaiah and Chowdapurkar (2012) in a study involving undergraduate PT students. It has been described as a useful modality to facilitate the learning of surface anatomy where classes are large (Estai and Bunt, 2016; Op Den Akker et al., 2002). Body painting can be also used in combination with other modalities as seen in a multi modal study

(Nicholson, Reed and Chan, 2016). Medical students found the body painting experience to be enjoyable but they also felt that it helped them remember anatomical knowledge (Estai and Bunt, 2016; Finn and McLachlan, 2010).

In a unique study carried out by Gangata (2008) in Cape Town South Africa an exercise termed the MCOE was tested on a cohort of undergraduate PT students together with an undergraduate group of occupational therapy (OT) students. It involved the students cutting out and pasting the correct muscle over the correct area on a skeleton. Not unlike the body painting exercise described by Finn and McLachlan (2010) for medical students the allied health science students found the experience of a 'cut out and paste' exercise fun and enjoyable and useful in the learning of gross spatial anatomy. Despite much positive feedback regarding the use of the afore-mentioned living and surface anatomy modalities certain limitations on their use have been encountered due to gender, area of body to be used and religious concerns (Reid et al, 2012; Rees, 2009; Rees, 2007). In 1998 in two separate studies it was found that the majority of female Muslim students cited religion as the reason for not wanting to take part in peer physical examination (Das, Townsend and Hasan, 1998; O'Neill et al., 1998). In a study in Saudi Arabia surface anatomy was taught by giving medical students two A4 sized images of the abdomen together with reading material. After studying the reading material the students of the intervention group drew the surface anatomy of six abdominal organs on the provided images. There was an improvement from pre-intervention to post-intervention results (Azer, 2011). Full body digital X-Ray images can also be used to enhance a student's ability to locate anatomical structures in the surface anatomy context (Kotzé, Mole and Greyling, 2012).

These methods, of teaching surface anatomy, might be considered for use in countries where there are religious, gender or cultural bars to the use of peer physical examination or body painting. However, the value of the use of peer physical examination and palpation in living anatomy is that it introduces students to the concept of being hands on with a patient in the clinical setting and promotes professional conduct (Chinnah, de Bere and Collett, 2011).

2.1.4.6 **Lecture-based/ didactic teaching**

Formal lectures have been included in gross anatomy programmes from as long ago as the 16th Century (Vasquesz et al, 2007). With the introduction of the problem based learning format there was a move from teacher-based anatomy education to student-centred active participation learning (Amoako-Sakyi and Amonoo-Kuofi,

2015) and as a result time spent by students in lecture decreased. The use of lectures has been described as passive learning, old-fashioned and ineffective (Pawlina and Lachman, 2004; Nandi, 2000). Indian medical students did not like the use of lectures and felt that dissection was a better teaching tool (Nagar et al., 2012). In a study that compared the use of a computer learning methodology and a lecture presentation of the same anatomical information the PT students that had been exposed to the computer depiction of the work fared better in an anatomical landmark identification test than those who had only received the lectures (Lee and Allison, 1992). It is now common to see a decrease in the number of lectures in gross anatomy programmes and many times they are only included in multi-modal or settings such as that researched in Australia by Green and Whitburn (2016) where they gradually reduced the lecture time for PT students from 25 hours to 10 hours over a three-year period. However, in this regard Shead et al. (2018) in South Africa reported that time spent in lectures was high compared to that found in the study carried out by Green and Whitburn (2016).

2.1.4.7 **Multi modal learning and blended learning**

Reidenberg and Laitman (2002) stated that the new generation of medical students have a different attitude to the learning of anatomy than their predecessors and because of this a multi-modal approach with new innovative ways of teaching and learning have to be implemented in anatomy programmes. In this regard Anderson and Conley (2000) added a computer assisted learning programme to other teaching methods that included the use of radiographs, Magnetic Resonance Imaging (MRI), surface anatomy, anatomical models and lectures in an anatomy programme for PT students.

McKenzie and Gutierrez (2007) included an evidence-based, multi-model and progressive type of learning platform that integrated the use of dissection, prosection and living anatomy concepts with clinical internship for first and second year DPT students. Nicholson, Reed and Chan (2016) explored the use of four innovative interventions namely body-painting, white boarding, clay modelling and quizzes in multi-modal anatomy workshops for an interdisciplinary collection of health science students that included PT students. Although no individual statistical data was given for the PT student group overall the majority of students found that the workshop improved their academic performance and helped them prepare for examinations.

In a study of e-book learning Stirling and Birt (2014) investigated the use of an e-book application in the teaching of anatomy to 71 first year medical students in Australia.

They concluded that this method of teaching gross anatomy could be used together with traditional anatomy teaching methods but also recommended that the timing of the interactive multimodal intervention could be crucial to the students' learning outcomes.

Recently Green and Whitburn (2016), in a study using undergraduate PT students, looked at the progressive introduction of interactive videos to replace hours spent in lectures over a three-year period. Practical classes and clinical anatomy classes were reduced minimally in the same time period. They reported good outcomes but emphasised the need for the practical interpersonal relationship that occurs in the practical classes to be continued in tandem with the interactive videos. In their most recent study Green et al. (2017) linked positive learning outcomes in PT students with the amount of engagement that these students had with online interactive videos and asynchronous discussion forums using a structural equation model.

2.1.4.8 **Virtual reality and Immersive learning**

Simulation has in recent years been taken one step further with the advent of virtual and augmented reality offer the student an immersive experience. Tworek et al. (2013) developed the LINDSAY Virtual Human Project software as a progression to other 3D and layering software packages. Their software had a higher resolution and the ability to manipulate and rotate the offering within the slides. Resultant qualitative responses from students pinpointed the fact that students had difficulty using the software resulting in time being wasted on trying to get the software to work rather than on learning content. The researchers concluded that 'we should not respond to the digital for the sake of the digital' but use in to ensure effective learning by students. Moro et al. (2017) found greater student engagement with this experience than found using tablet devices but no increase in assessment scores were noted with using any of the methosologies for learning. The virtual reality experience did results in some adverse reactions such as headaches, dizziness or blurred vision in some students. However, the researchers felt that the results point to the usefulness of such modalities as adjunct teaching methods in anatomy.

2.1.4.9 **The use of 3D printing in anatomy education**

The latest addition to the use of technology to produce the 3D perspective for anatomical learning is the development of 3D printing. The value of 3D printing was illustrated by a study conducted in the UK by Smith et al. (2017) that found the use of such models in a small group tutorial resulted in a significant increase in knowledge

about the topic over results opbtained using 2D methodology. Added value to the experience was that the students were able to use the models in their home environment.In the main 3D printing produces rigid replicas of anatomical structures. However, in a recent study conducted in Singapore this type of anatomical representation for the functional aspects of a knee joint simulator was found to be beneficial to student learning (Cai et al., 2018). While this mode of delivery of anatomical knowledge has many benefits the ethical issues relating to the use of cadaveric remains as a source for reproduction of body parts still need to be addressed (Jones, 2018).

2.1.5 Curricular Inclusion of Learning Programmes

There are many methods and types of programmes that have been incorporated into anatomy curricula to direct, enhance and compliment the main anatomy pedagogies. Some of these curricular inclusions are used in isolation and some are used in combination with others.

2.1.5.1 Problem-based learning and integrated learning

The establishment of problem-based learning at McMaster University in Canada in 1975 resulted in an approach to anatomical learning that saw the integration of gross anatomy with pathological information and the studying of clinical scenarios (Louw, Eizenberg and Carmichael, 2009; Paulsen, Klement and Wineski, 2005). With the introduction of the problem-based learning format there was a move from teacher-based anatomy education to student-centred active participation learning (Amoako-Sakyi and Amonoo-Kuofi, 2015; Singh and Kharb, 2013). In 2010 the Carnegie Foundation once again set about examining medical education in the USA and concluded that a balanced integration of formal learning that included the learning of a basic science such as anatomy should be pursued in conjunction with clinical experience (Irby, Cooke and O'Brien, 2010).

An Australian student's perspective of the integrated format, including the teaching of broad skills using problem-based learning in small groups, was critical of it as he felt that it divided anatomy up into small clinically significant pieces and destroyed the concept of a systematic approach to the subject (Linacre, 2005). This fragmentation aspect of peer-based learning was also associated with a difficulty to fully understand anatomy (Weatherall, 2000, 2006). The 'piecemeal' integrated curriculum of either problem-based learning or systems-based learning was also reported as being detrimental to a coherent comprehensive picture of the gross anatomy of the whole body (Bergman, van der Vleuten and Scherpbier, 2011) and problematic to students

due to the disjointed nature of the presentation of the information to be learnt (Brooks et al., 2015). Linacre (2005) also discussed the element of small group dynamics that might see very few students being prepared for the session that then disintegrated into a general chat about other non-anatomical matters. Furthermore such small group sessions may be more attuned to the needs of extrovert or dominant students (Linacre, 2005). Hinduja, Samuel and Mitchell (2005) compared a traditional anatomy programme with a peer-based learning programme and concluded that a good grounding in anatomy and better recall of anatomy after 12 months was attained using the traditional programme. However, this finding is in contrast with the results of Prince et al (2003).

In the UK from 2009 there was a significant decrease in the amount of gross anatomy being taught to medical students. The change from cadaveric dissection led to the use of other teaching modalities such as problem-based learning, use of prosections, the use of models and plastinated specimens, computer-based learning and radiological imaging (Moxham et al., 2016; Riederer et al., 2015). In 2010 researchers at the McMaster University in Canada revised the anatomy curriculum but still maintained the basic problem-based learning format using small tutorial group teaching. However, they focussed on conceptualisation and the use of repetition of examples to reinforce the learning of concepts. These researchers also reported that the changes in the curriculum had led to a change in the way in which the tutorial material was written and delivered to the students and that web-based resources had been integrated into the curriculum and this improved the learning within the small groups of students (Neville and Norman, 2010).

Within the category of integrated learning there are the concepts of horizontal and vertical integration. It was reported by Swedish researchers that horizontal integration that comprises the interaction between the basic sciences in a medical curriculum is essential for the best outcomes from problem-based learning (Dahle et al., 2002). The same study looking at the advantages or disadvantages of vertical integration between clinical elements and basic sciences such as anatomy in a problem-based learning curriculum found that it was supported by vertical integration and that its use encouraged deep learning that was continuous throughout life (Singh and Kharb, 2013; Dahle et al., 2002). Bergman, van der Vleuten and Scherpbier (2011) suggested that in the future more research on the concept of vertical integration in anatomical education should be carried out as per the guidelines suggested by McMaster University in Canada. This might solve the problems of contextual teaching and repetition. Researchers at Peking University used separate systemic and regional approaches with the latter approach being associated with problem-based

learning (Wang et al., 2010). These researchers found that the latter approach that incorporated clinical learning was beneficial to students by enhancing their learning of anatomy and preparing them for future clinical practice.

The initial integrative format and use of problem-based learning that was uniformly applied in medical schools in the USA initially eventually gave way to greater diversity with different blends of traditional, integrated and problem based learning styles being utilised and in some cases one or more of these were dropped from the curriculum (Paulsen, Klement and Wineski, 2015). These authors felt that the variations in approach to anatomy curriculum could lead to better student adaptability to the ever changing professional environment that they could encounter post medical school. However, they point out that in recent times the integrative process has been revisited by individual medical schools in their own fashion. In this regard, recently, an integrated systems-based, compressed medical school anatomy curricula, where the programme was reduced from 130 hours to 105 hours, reportedly improved students' performance in gross anatomy (Halliday et al., 2015). This evolution in the basic Flexner concept has also been noted in an overview of reports submitted by medical schools in Canada and the USA (Anderson and Kanter, 2010).

2.1.5.2 **Case-based learning**

The goal of case-based learning is the use of authentic clinical cases to ready students for professional practice. In so doing it connects the theoretical aspects of anatomical knowledge to clinical practice and encourages question-based learning methods (Thistlewaite, 2012). In a comparison of problem-based learning and case-based learning researchers stated more preparation by students and guidance by lecturers was seen in the latter case presentation scenario than in the former case presentations (Srinivasan et al., 2007). Furthermore with problem-based learning the topic and way of learning it are equally as important but in case-based learning objectives are formulated up front in the process and then an attempt is made to try and meet them (McLean, 2016). Case-based learning is associated with deeper learning (McLean, 2016).

A Nigerian review conducted in 2014 by Osinubi and Aloje-Ibru, which included PT students among others, found that traditional methods of teaching gross anatomy did not address the issues of student critical thinking, creativity, self-study, collaborative learning and communication. They recommended that medical training institutions perhaps should consider introducing case-based learning in their curricula to address these problems. An Indian study felt than at the onset of the learning of anatomy by

medical students case-based learning encouraged student-based learning and facilitated practical application of the knowledge learnt (Singh and Bhatt, 2011). In a pilot study where undergraduate PT and OT students were exposed to vertical integration and case-based learning by the use of a case presentation related to respiratory anatomy, both groups of students reportedly had beneficial outcomes (Parmar and Rathinam, 2011).

2.1.5.3 **Inter-professional education or inter-disciplinary learning**

This type of learning occurs when two or more different student professional disciplines undertake a learning programme together and work out their strategies to complete a task together. A study was conducted where the participants were undergraduate medical and PT students. The students were assigned to inter-disciplinary dissection teams and assessed pre- and post- intervention using the Readiness for Inter-professional Learning Scale (RIPLS). The qualitative data collected revealed an appreciation for the chance to meet and work with students from another discipline, the development of a team approach and an increased understanding of the professional role of the other discipline (Sytsma et al, 2015). In a study where PT students were placed in inter-professional education groups with biomedical sciences, nursing, radiography and medical students the PT students felt that the multi-disciplinary approach gave them insight into teamwork between the professions for future clinical practice (Mitchell, McCrorie and Sedgewick, 2004).

It can be seen from the following studies that there is a diverse combination of students undertaking interventions with other student disciplines. In one study PT students were combined with OT, health science, exercise and sports science and exercise physiology students (Nicholson, Reed and Chan, 2016). In another study carried out in Spain the students joining the PT students were OT, nutrition, physical education and psychology students (de Oliveira et al., 2015) and yet another two paired DPT and medical students (Shields et al., 2015; Hamilton et al., 2008). Fernandes et al. (2015) grouped PT, midwifery, OT, nursing and physician's assistant students to see how the diverse groups interacted and what the groups perceived as the value of such an exercise. Again a positive response was received from the students and matters such as respect for each others profession and improvement in communication across disciplines were highlighted. Biomedical sciences, PT, nursing, radiography and medical students undertook an inter-professional education intervention involving working with cadaveric material in order to assess student attitudes in that regard but also in regard to student perceptions and opinions on inter-professional education (Mitchell, McCorie and Sedgewick, 2004). The above

evidence shows that very often PT students are grouped with OT students in studies of this nature but there is often great diversity in the choice of other allied health student groups interacting with PT students in such study interventions.

2.1.5.4 **Team-based learning and peer teaching**

Team-based learning seeks to correct some of the problems with small group dynamics (Nieder et al., 2005). Some of the identified problems in this regard reported by Linacre (2005) have been described previously this literature review. The design of the TBL is more focussed and planned, than ordinary small team activities and include student readiness assessment sessions and peer review (Nieder et al., 2005). These researchers found that team-based learning was most beneficial to students who were at risk of failure with other methodologies as it encouraged continuous study. An Iranian study found that team-based learning either alone or together with traditional lectures enhanced learning in their medical students (Ghorbani, Karbalay- Doust and Noorafshan, 2014). Team-based learning fostered a motivational feeling that guided the attitude of being a responsible member of a team and a contributor to the integrative learning by the team (Vasan, DeFouw and Compton, 2011). In this study the students' performance improved as students engaged in active learning and peer teaching. In a comprehensive team-based learning intervention using DPT students' positive academic outcomes and retention of anatomical information was noted (Huitt, Killins and Brooks, 2015).

2.1.5.5 **Peer teaching and tutoring**

A method of peer demonstrations was tested by Krych et al. (2005) with improved understanding and retention of anatomical knowledge and improved communication skills. Teaching where student groups were rotated between dissection and the teaching of structures dissected by peers were found to be an effective method of imparting anatomical knowledge (Wilson et al., 2011; Sandra and Ferguson, 2009). During a peer teaching intervention for DPT students an Audience Response System was used with favourable results. The students liked the immediate and direct format and felt that the process encouraged deeper consideration and understanding of the topics raised (Wait et al., 2009).

2.1.5.6 **Asynchronous online discussion groups and quick response (QR) codes**

Green and Hughes (2013) and Green et al. (2014) looked at the use of asynchronous online discussion groups to enhance the learning experience of PT students in Australia. This use of computer technology to facilitate the answering of questions posed by students to each other online is sometimes associated with blended

learning models. The participation occurs in a random fashion and undetermined rate and is enjoyed by students. In the afore-mentioned studies in this regard the results were positive with respect to learning outcomes and this was reflected in improved final gross anatomy examination marks. Green and Whitburn (2016) in a study of blended learning continued the use of asynchronous online discussion groups as an adjunct to the blended learning approach being investigated. With the advent of cell phone and tablet technology the development of QR code tagging of cadaveric specimens has become more common. The process allows the student to observe the specimen, attempt to answer the required question(s) regarding a particular structure and then check the answer to the question by scanning the QR code tag. A study by Traser et al. (2015) reported that although the students liked the QR code intervention there appeared to be no beneficial impact of it on practical examination results.

2.1.5.7 **Student assessment in anatomy programmes**

The way in which student performance in the anatomy programme is assessed has to be considered in an anatomy curriculum. The examination format can also be considered in relation to the more efficient evaluation of student anatomical knowledge. Fabrizio (2013) reported on the use of oral examinations (viva voce) in place of more traditional spot test laboratory examination methods for PT students. He stated the case that oral examinations are better as they use less time in preparation, avoid the need for the laboratory to be closed to students for a number of days prior to the examination and are more linked to the way in which the students have to think clinically. Furthermore, Zhang et al. (2013) noted that there was no difference between a student's ability to answer spot questions on a timed or untimed examination format. When a comparison of student results using the traditional 'steeplechase' spot test examination format and an online examination version was made researchers found no difference and recommended online examinations could be used for assessment by anatomists with confidence (Meyer et al., 2016).

Hence the challenge of the future gross anatomy curriculum structure appears to be to create one that can incorporate traditional cadaveric dissection together with new modern multi-modal and multi-disciplinary teaching elements despite time constraints due to decreased teaching hours given to anatomical science. A number of studies propose that the anatomy curriculum should be closely linked to clinical significance. Recently it has been pointed out by two anatomists that as the role of anatomy educator for undergraduate medical students decreases anatomists should be looking forward and establishing more relevant anatomical post graduate education

thus helping to address the perceived levels of poorer anatomical competency by practitioners and perhaps preventing anatomical mistakes that can be costly in terms of human life. These researchers postulate that ‘there are so many bridges waiting to be built’ (Pawlina and Drake, 2017).

Section 2 of the literature review consists of pertinent literature pertaining to a description of PT, guidelines for PT practice, the concept of autonomous practice and levels of PT education globally and is presented below.

2.2 SECTION 2: PHYSIOTHERAPY PRACTICE GUIDELINES AND THE SPREAD OF PHYSIOTHERAPY EDUCATION GLOBALLY

This section will look at defining physiotherapy, a historical perspective of PT education, guidelines for PT education and practice nationally and internationally and international collaboration to develop PT programmes in developing countries.

2.2.1 Physiotherapy/Physical Therapy (PT)

Physiotherapy is a service-based profession that offers healthcare to individuals, groups or populations. Problems treated may result from ageing, conditions, diseases, disorders, environmental factors, injury and pain (WCPT, 2015). Treatment is aimed at developing, maintaining or restoring maximal movement and functional ability from the cradle to the grave. Functional movement is an integral part of healthy living. In this regard, Cott et al. (1995) proposed ‘the movement continuum theory of physical therapy’. They argued that a physotherapist’s ability to conceptualise movement at both the micro and macro levels differentiated the profession from others. Hence, a physiotherapist exhibits a unique and holistic approach to movement rehabilitation that considers the psychological, social and physical aspects of the patient’s condition in order to facilitate maximal patient recovery. Quality of life (QoL) assessment and the creation of a maximal QoL for a patient utilising their movement potential is carried out through tactics such as promotion, prevention, intervention/treatment and rehabilitation (WCPT, 2015). During the PT engagement interaction is fostered between the physiotherapist, patients/clients, families, caregivers, other health professionals and communities in order to complete an assessment of the patient’s movement potential and set treatment goals using the unique skills and knowledge of the physiotherapist. The emotional, physical, psychological and social wellbeing of the patient is encompassed in the entire approach of PT practice (WCPT, 2015). The dynamic response of PT practice is guided by the health needs of the patient/client and the society in which the practice

is operating. As many communities consist of multi-cultural groups it is important that consideration is also given to preparing students to develop cultural competence in order to offer effective patient care (Schwartz and Hightower, 2017). Nowadays, the premise of evidence–based practice (EBP) and review as knowledge and technology are advancing constantly must be embodied in the scope of practice. In this respect research is guiding the evidence for new practice directions (WCPT, 2015) and through its introduction into undergraduate PT research methodology encourages adherence to the principles of EBP even before entry into the clinical sphere (Burger and Louw, 2017). The role of problem-based learning in gross anatomy programmes has been documented in Section 1 of this literature review. Within an EBP and research curriculum a UK study reported that the Evidence Informed Practice module was delivered using problem-based learning to test how PT students adapt to this pedagogical approach in order to formulate ways for students to adapt to it (Steele and Igo, 2017). A recent Norwegian study that was presented at the 2017 WCPT congress in Cape town, South Africa added to the concept of EBP by including the 'intra-acting' of knowledge at the clinical level and knowledge based on patient input to the treatment session. The PT students surveyed rated the need for relational competence highly and directly associated this with the physiotherapist's ability to involve the patient in a treatment session (Dahl-Michelsen and Groven, 2017). Hence, the construct of EBP is multifaceted.

A physiotherapist can be an independent practitioner and therefore can assume roles such as patient/client care, consultant, educator, manager, policy maker and researcher (WCPT, 2011). They can also be part of health care provider teams working within the ethical confines of WCPT principles (Cott et al., 1995; Higgs and Jones, 1995). When these authors stated these facts, they could have hardly envisaged that so many physiotherapists would attain independence (autonomy) in their profession. The Vision 2020 statement that predicted autonomy for PT practitioners was formulated in 2007 and revised in 2013 by the American Physical Therapy Association (APTA, 2017). Two types of autonomy have been defined. Technical autonomy is the 'right to use discretion and judgement for the performance of work' (Freidson, 1970 cited in Sandstrom, 2007). However, technical autonomy is subject to regulation by professional boards that dictate standards of practice, control accreditation and license practitioners (Freidson, 1970 cited in Sandstrom, 2007). Socioeconomic autonomy is 'the ability of the worker to ascertain and allocate the economic resources needed to complete work' (Freidson, 1986 cited in Sandstrom, 2007). However, pure autonomy is unrealistic and therefore the formation of societies

and other bodies to assist practitioners is necessary (Freidson, 1986 cited in Sandstrom, 2007).

2.2.2 Historical Perspective of Physiotherapy/physical Therapy Educational Development

Physiotherapy may have developed from Chinese origins as early as 3000 BC and Hippocrates (460-377 BC) associated it with what he called 'friction massage' (Moffat, 2012; Calvert, 2002). In the 16th century the Greeks used therapeutic exercise and massage (Moffat, 2012) and exercise to cure ailments in Italy (Ford, 1954 cited in Moffat, 2012). However, the creation of PT as a profession is attributed to Per, Hendrik Ling who established the Royal Central Institute of Gymnastics in 1813 in Sweden (Moffat, 2012). In 1944, the Chartered Society of Physiotherapy that had previously been the Chartered Society of Massage and Medical Gymnastics from 1913 was established in the UK (Wicksteed, 1948 cited in Moffat, 2012). Australian physiotherapy and that in other British colonies had similar chronological origins to the British model. The first School of Physiotherapy in New Zealand was founded in 1913 (Wicksteed, 1948 cited in Moffat, 2012).

2.2.2.1 South African physiotherapy heritage

The first PT programme in South Africa was established at WITS. At the outset in 1938 the PT diploma offered to students took three years to complete. In 1943 the diploma was replaced by a degree consisting of four years of full time study that was established under the leadership of Professor Raymond Dart, an anatomy professor and Dean of the Medical School at WITS from 1925-1943 (Myezwa, Stewart and Mudzi, 2013; Tobias, 2007). Thereafter, anatomy became consolidated in the undergraduate PT course. Other universities in this country began to establish PT courses, with anatomy as a compulsory inclusion, in the fifties. The first PT diploma intakes occurred in 1950 and 1957 respectively at the University of Pretoria (UP) and University of Cape Town (UCT) (University of Cape Town, 2017; University of Pretoria, 2017). The Sefako Makgatho University (SMU), formerly the Medical University of South Africa (MEDUNSA), and the University of KwaZulu- Natal (UKZN) introduced a PT course for students of colour in 1979 (University of KwaZulu-Natal, 2017; Mbambo, 2004). All degrees are now standardized to four years duration but timing of the inclusion of anatomy in the course curriculum varies between faculties. Anatomy is taught to PT students in the first year at UP, the University of the Free State (UFS) and the University of the Western Cape (UWC). At WITS, SMU and the UKZN it is taught in the second year while at the University of UCT and Stellenbosch University (SUN) it is integrated with physiology over the first two years of the degree

programme. In keeping with a new awareness of making PT education available to those with disability visually impaired undergraduate PT students are trained at the UWC (University of the Western Cape, 2017).

With reference to the previous points the different types of PT degree programmes offered worldwide are designed to accommodate the needs that pertain to the specific PT practice in each of those countries (World Confederation for Physical Therapy (WCPT), 2015). In South Africa physiotherapists assume the role of first line practitioners (Health Professional Council of South Africa (HPCSA), 1985). Hence, they are autonomous PT practitioners and that role brings the ethical responsibility that pertains to a social contract with the public to honour their trust by exercising professional conduct in all aspects of their clinical practice (Sandstrom, 2007). This means that such physiotherapists are permitted to have access to patients without having to have them referred by another health care professional and can therefore work independently; can offer a diagnosis pertaining to the patient's illness within their scope of practice and can refer a patient to a specialist clinician if they feel that the condition is beyond their scope of practice. They can also write sick notes for patients and administer prescribed medicines (South African Society of Physiotherapy (SASP), 2014). First line PT practitioners are also found in Australia (Australian Physiotherapy Association (APA), 2015, in the United Kingdom (UK) (Chartered Society of Physiotherapy (CSP), 2017) and in New Zealand (New Zealand Physiotherapy Association (PNZ), 2015) but in many countries, including France, Italy and Germany, physiotherapists have not been given first line status (WCPT, 2017). In the United States of America (USA) the autonomy of the physical therapy practitioner falls into the unlimited, limited or no access categories dependent on State legislation (American Physical Therapy Association (APTA), 2011).The fact that in South Africa physiotherapists are autonomous practitioners means they shoulder the responsibility of being able to diagnose and treat a patient's medical condition within their scope of practice. This necessitates that they achieve a high level of anatomical competency and hence an emphasis on appropriate and sufficient anatomical preparation for clinical practice is essential.

2.2.3 **The World Confederation of Physical Therapy**

In 1951 the WCPT was founded with the intention of uniting physiotherapists throughout the world. This non-profit organisation that began with eleven members now has 111 members worldwide and represents more than 350 000 physiotherapists (WCPT, 2017). The founding members were Australia, Canada, Denmark, Finland, Great Britain, New Zealand, Norway, South Africa, Sweden, West

Germany and the USA. In the first ten years, the membership grew to 16. Consultative status with the United Nations and an official relationship with the World Health Organisation (WHO) created international recognition. They are now five regions namely Africa, Asia and Western Pacific, Europe, North America/ Caribbean and South America (WCPT, 2017). In 1995, the first policy statements and guidelines pertaining to education, practice and research were formulated. In 2015, they were updated.

The WCPT website gives a short profile of each affiliated country within the regional categories. Included in these profiles is the information summarised in Table 2.1. This table will be used as a template to further discuss pertinent aspects of the available information.

In the African region South Africa, Nigeria, Egypt and Zimbabwe joined the WCPT before the 1990's and they, with the exception of Zimbabwe, have more practising physiotherapists than the rest of the continent. Their early affiliation with the WCPT possibly gave them an awareness of developing PT education and practice. Notably, of the afore-mentioned countries South Africa is the only one to offer a doctoral degree. However, 65 % of these countries have physiotherapists who work as autonomous practitioners and this is the highest out of all the regions (WCPT, 2017).
On the African continent the number of PT programmes offered has increased especially since the 1990s. Some of the developing nations are being helped to develop their PT courses. In this regard, Sudan, an impoverished country, has established links with physiotherapists at a University in Norway. This collaboration has resulted in valuable information about how such a relationship should be planned and undertaken in order to achieve beneficial outcomes (Haugland et al., 2014). In Table 1, Tanzania offered no information about the state of PT in that country. However, a presentation at the recent 2017 WCPT Congress in Cape Town, South Africa offered some insight into the subject. Collaboration between Sweden and Tanzania between 2008 and 2015 resulted in the University of Addis Ababa developing a PT course offering a diploma and a bachelor's degree. Furthermore, a master's programme is being developed and more interaction and movement of lecturers between the two universities is envisaged (Mkoba, Sörlin and Sundelin, 2017). An intercultural collaboration between Denmark and Zanzibar, Tanzania has resulted in the first cohort of PT students graduating (Holm et al., 2017). Ethiopia despite its challenges relating to human, monetary and PT educational development encouraged leadership roles in its PT population and with guidance from an American university developed a generic DPT programme for the country (Footer et al., 2017).

Although not yet a member of the WCPT in line with the WCPT's Strategic Plan Sierra Leone is receiving help from academics in Denmark, Ghana and the USA to develop a degree-based PT programme in the country (Kennedy et al., 2017).

Table 2.1: Demographics of Regional Distribution and Professional Information of WCPT Member Countries (2017)

* Autonomous, B: Bachelors, D: Doctorate, Dip: Diploma, GD: Graduate diploma, M: Masters, PG: Postgraduate, PT: Physiotherapy, UG: Undergraduate, WCPT: World Confederation of Physical Therapy

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male ratio	Number of programmes	PT qualification (s) Undergraduate (UG) Postgraduate (PG)	Length of UG course (years)	Scope of practice	Number of specialisation groups
AFRICA	Benin	2015	130	0.66:1	3	UG B PG M	3	1. Access to patients 2. Diagnose 3. Treat 4. Refer on 5. Offer preventative care	1
	Congo (DR)	2015	-	-	-	-	-	-	0
	Egypt	1978	3 000	-	3	UG B PG GD/M	5	1-4	9
	Ethiopia	1999	300	-	1	UG B PG M/ D	3-4	1-5 and 6. Are autonomous *	14
	Ghana	1999	± 150 (Dec 2016)	1.16:1	1	UG B	4	1-6*	0
	Kenya	1982	± 600	-	3	UG Dip/B	3	1-5	7
	Malawi	1999	92	1.25:1	1	UG B	5	1-6*	1
	Mauritius	2011	± 90	1.73:1	1	UG B	4	1-6*	0
	Namibia	1995	105	4.44:1	0	-	-	1-6*	0
	Niger	2015	± 45	0.25:1	1	UG Dip	3	1-5	0
AFRICA	Nigeria	1967	± 1 250	-	7	UG B	5	1-5	8
	Rwanda	2007	±260	-	1	UG B	4	1-6*	4
	South Africa	1951	6 500	10.09:1	8	UG B PG GD/ M/ D	4	1-6*	18
	Sudan	Provisional	±240	0.88:1	7	UG Dip PG B/M	3	1,3,4,5,6*	18
	Swaziland	1999	± 23	4.25:1	0	-	-	1-6*	0
	Tanzania	1995	-	-	-	-	-	-	-
	Togo	2015	± 308	-	1	UG B	3	1-6*	2
	Uganda	1995	± 250	0.5:1	2	UG Dip/ B	3	1-6*	2

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male ratio	Number of programmes	PT qualification (s) Undergraduate (UG) Postgraduate (PG)	Length of UG course (years)	Scope of practice	Number of specialisation groups
	Zambia	1992	±370	-	2	UG Dip/ B PG GD/M	3	1-6*	4
	Zimbabwe	1970	320	-	1	UG B, PG M	4	1-6*	3
ASIA WESTERN PACIFIC	Afghanistan	2007	± 400	0.55:1	1	UG Dip PG GD	3	1,3,4,5	0
	Australia	1951	30 351	2.08:1	40	UG B PG GD/ M/D	2	1-6*	17
	Bahrain	2007	-	-	-	-	-	-	-
	Bangladesh	2007	± 800	-	1	UG B PG M	5 +1 for internship	1-6*	0
	Cambodia	2007	±350	0.39:1	3	UG Dip	3	1-6*	3
	Fiji	1995	±68	2.33:1	1	UG B	3	1-6*	2
WESTERN PACIFIC REGION	Hong Kong	1978	2 619	1.56:1		UG B PG M/D	4	1,3,5	10
	Indonesia	1991	±10 000	-	42	UG Dip	-	1,3,5	4
	Iran	1982	-	-	-	-	-	-	-
	Japan	1970	129 931	0.68:1					18
	Korea (South)	1974	22 800	-	74	UG Dip PG B/ M/ D	3	3,5	9
	Kuwait	1999	± 880	2:1	1	UG B	4	1,3,5	22
	Macau	2011	±130	1.8:1	0	-	-	1-6*	1
	Malaysia	1974	-	-	-	-	-	-	-
	Mongolia	2015	± 62	30:1	1	UG B PG M	4	1,2	0
	Myanmar	2016	-	-	-	-	-	-	-
	Nepal	2003	± 501	-	3	UG B PG GD	4.5		0
	New Zealand	1951	4 567	4.16:1	2	UG B PG GD/ M/ D	4	1-6*	11
	Oman	2011	± 300	-	1	UG Dip/ B PG GD	5	1,3,5	5
	Pakistan	2011	± 3 500	0.55:1	1	UG M/ D	5	1-6*	0
	Philippines	1970	24 216	-	94	UG B	5	1-5	1

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male ratio	Number of programmes	PT qualification (s) Undergraduate (UG) Postgraduate (PG)	Length of UG course (years)	Scope of practice	Number of specialisation groups
						PG M			
	Saudi Arabia	2003	± 2 550	1.4:1	12	UG B PG M/ D	4	1,2,3,5	10
	Singapore	1982	1 340	2.15:1	1	UG B PG M/ D	4	1-6*	6
	Sri Lanka	2003	± 440	0.78:1	2	UG Dip PG B	3	1-5	19
	Taiwan	1982	5 117	1.65:1	14	UG Dip PG B/M/D	4	1,3,5	11
	Thailand	1978	± 8 000	-	16	UG B PG M/ D	4	1-5	2
	United Arab Emirates	2007	± 1 500	3.7:1	3	UG B PG	4	1-6*	3
EUROPEAN	Albania	2015	-	-	-	-	-	-	-
	Austria	1967	± 7 500	4.56:1	10	UG B PG M	3	1,2,3,5	11
	Belgium	1956	± 29 000	1.14:1	14	UG M PG D	4-5	1,3,5	7
	Bosnia and Herzegovina	2015	1 600	1.07:1	6	UG B PG M/ D	3	1,3,5	-
	Bulgaria	1995	500	-	3	UG Dip	3	3,5	5
	Croatia	1999	-	-	-	-	-	-	-
	Cyprus	1988	± 833	1.02:1	6	UG B PG GD/ M/ D	4	1,3,4,5,6*	2
	Czech Republic	1995	±8 000	10.27:1	1	UG B PG GD/ M	3	1,3,5	1
	Denmark	1951	15 384	2.57:1	1	UG B PG M/ RD	3.5	1,3,4,5,6*	16
	Estonia	1999	± 800	13;1	2	UG D PG M	3	1,3	2
	Finland	1951	15 041	6.13:1	15	UG B PG M/ D	3.5	1,3,5,6*	9
	France	1970	75 164	1.26:1	42	UG B	4	1,3,5	1
	Germany	1951	183 000	-	280	UG Dip PG B/ M	3	1,3,5	18
	Greece	1974	-	-	-	-	-	-	-

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male ratio	Number of programmes	PT qualification (s) Undergraduate (UG) Postgraduate (PG)	Length of UG course (years)	Scope of practice	Number of specialisation groups
EUROPEAN	Hungary	1995	4 000	30.67:1	6	UG B PG GD/M/ D	4	1-6*	16
	Iceland	1963	± 550	2.57:1	1	UG B PG GD/ M	4	1-6*	9
	Ireland	1988	± 3 500	2.91:1	6	UG B PG GD/M/D	4	1-6*	14
	Israel	1956	4 500	-	5	UG B	4	1-6*	20
	Italy	1995	± 55 000	-	37	UG B PG M/ D	3	1,3,5	8
	Jordan	1995	±1 500	-	3	UG B	4	1,3,5	8
	Latvia	1999	1 195	-	3	UG B PG M	4	1-5	2
	Lebanon	1991	±1 200	-	1	UG B, PG M/D	4	1-5	6
	Liechtenstein	1995	95	-	0	-	-	3,5	2
	Lithuania	1999	800	-	11	UG B PG M/D	3	1-6*	0
	Luxembourg	1978	±1 000	1.23:1	0	-	-	1,3,5	0
	Malta	1999	± 340	3:1	1	UG B	4	1-6*	1
	Montenegro	2015	± 345	2:1	2	UG B PG GD	3	-	21
	Netherlands	1956	38 000	1.34:1	11	UG B PG M/D	4	1-6*	14
	Norway	1951	12 581	-	5	UG B PG M/D	4	1,2,3,5,6*	12
	Poland	1967	45 000	-	-	-	-	1-6*	14
	Portugal	1963	6 912	4.26:1	19	UG GD PG M/ D	4	1-6*	10
	Romania	1999	±3 000	1.25:1	2	UG GD PG M/D	3	1,3,5	0
	Serbia	1999	3 200	-	2	UG D	4	1,3,5	3
	Slovakia	2011	±3 000	7:1	2	UG D PG M/PD/D	3	1,3,5	0
	Slovenia	1995	± 1 000	2.25:1	2	UG B PG M	3	1,3,5	7
	Spain	1974	± 43 000	1.5:1	55	UG B	4	1-6*	17

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male ratio	Number of programmes	PT qualification (s) Undergraduate (UG) Postgraduate (PG)	Length of UG course (years)	Scope of practice	Number of specialisation groups
						PG M/D			
	Sweden	1951	12 310	4.56:1	8	UG B, PG M/ D	3	1-6*	13
	Switzerland	1963	±10 753	2.65:1	1	UG B PG M/D	4	1,2,3,5,6*	13
	Syria	2003	-	-	-	-	-	-	-
	Turkey	1974	8 004	1.57:1	67	UG B PG M/D	4	3	8
	Ukraine	2011	± 142	1.22:1	5	UG M PG GD/M/D	5	1-6*	0
	United Kingdom	1951	52 426	3.35:1	55	UG B PG GD/M/D	3	1-6*	19

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male Ratio	Number of programmes	PT qualification (s) UG and PG	Length of course (years)	Scope of practice	Number of specialisation groups
NORTH AMERICAN CARRIBEAN	Bahamas	2007	53	15:1	0	-	-	1,3,4,5	0
	Bermuda	1995	35	-	0	-	-	1,3,4,5,6*	3
	Canada	1951	20 842	2.62:1	15	UG M (after B) PG M/ D	2	1,2,3,5,6*	13
	Curaçao	1999	78	1:1	0	-	-	1,2,3,5	0
	Guatemala	1991	±350	-	0	-	-	1,3,4,5,6*	0
	Guyana	2007	30	-	0	-	-	1-5	0
	Jamaica	1970	± 140	6.2:1	1	UG B	4	1,3,4,5	0
	Panama	1991	-	-	2	-	-	-	-
	Puerto Rica	1988	-	-	1	-	-	-	1
	St Lucia	2015	12	-	0	-	-	1-6*	-
	Suriname	1974	57	3.44:1	1	UG M	3	1-6*	0
	Trinidad and Tobago	1999	84	6:1	-	-	-	1,3,4,5	-
	United States	1951	198 686	1.86:1	230	UG D	6	1-6*	16

WCPT Region	Country	Year of affiliation to WCPT	Number of practising PTs	Female to male Ratio	Number of programmes	PT qualification (s) UG and PG	Length of course (years)	Scope of practice	Number of specialisation groups
SOUTH AMERICAN REGION	Argentina	2011	± 35 000	1.81:1	28	UG B	5	1-5	7
	Bolivia	1995	-	-	-	-	-	-	-
	Brazil	2007	220 000	2.34:1	1089	UG B PG GD/M/D	4	1-6*	18
	Chile	1967	8219	-	100	UG B PG GD/M/D	5	1-5	10
	Colombia	1959	±20 000	9:1	35	UG GD PG M	4	1,3,5	13
	Ecuador	2003	±3 000	-	1	UG B	4	3,4	3
	Mexico	1970	3 057	-	10	UG B PG GD/M	4	1,3,4,5	5
	Peru	1999	2 000	2:1	10	UG GD	5	1-5	10
	Uruguay	1967	±1 860	-	3	UG B	5	1-6*	18
	Venezuela	1978	±3 000	-	5	UG Dip	3	1-6*	2

In the Asia and Western Pacific region the same trend can be seen with regard to the earlier WCPT affiliated countries having the most practising physiotherapists. Japan (129 931) has the greatest number of practising physiotherapists by far and is ranked fourth in the world in this regard behind Brazil (220 000), the US (198 686) and Germany (183 000). Ten out of the 27 countries listed (37%) offer a doctoral degree. In this region only 33% of physiotherapists practice autonomously and this may be partly due to the cultural nature of the bodies that control PT practice in some of the countries (WCPT, 2017). Cambodia is a country where in 2015 it was reported that there were only 446 qualified physiotherapists for a population of 15 million people (World Bank Cambodia, 2015 cited in Seiha and Aicha, 2017). Cambodian PT practitioners were not meeting quality assurance standards and so an evaluation of the PT associated degree was undertaken in March 2016. It was discovered that the learning outcomes of the students are limited, the academic staff are not sufficiently qualified and the approach to teaching teacher centred and not problem-based learning. Hence, the curriculum has to be re-evaluated (Seiha and Aicha, 2017).

The European region is made up of mostly well-established countries and yet less than half of the countries (46%) offer a doctoral degree and the same percentage do not allow autonomy of PT practitioners (WCPT, 2017). Surprisingly countries like France, Germany and Italy did not report autonomy in their data submission to the WCPT.

In the North American Caribbean region few countries submitted data on the state of the PT programmes. The US and Canada were the only two with doctoral programmes. Forty-three per cent of programmes reported autonomous PT practice.

In the South America region Brazil not only reported the most physiotherapists in practice in the South American region but they are autonomous and institutions offer doctoral degree programmes. Across this region the vast majority of countries offer a bachelors degree (WCPT, 2017; Moffat, 2012). In Equador a new PT educational programme is being developed (Cech et al., 2017).

Collaborative ventures are not necessarily only carried out on the African continent but due to the developing nature of the region it is probably not surprising that the majority of such interactions are based in Africa. However, a study reporting on assistance given by Japan and the USA to Nigeria, Suriname, Mongolia and Jordan highlights that the problem is not only in Africa (John et al., 2012). Countries that have large populations and few health care workers often have the largest global

burden of disease (Anyangwe and Mtonga, 2007; WHO, 2006). This collaboration resulted in provision of online knowledge to clinical physiotherapists, curricular consultations, assistance with new and current programmes and repatriation of physiotherapists to their home countries once they had achieved a DPT degree so they could teach PT students and raise standards (John et al., 2012). Hence, it is evident that PT programmes in the more affluent countries are coming to the aid of their colleagues in the less prosperous countries. This will foster closer ties between continents, help physiotherapists achieve new educational and clinical goals and reach out to help more patients that need their expertise.

The length of a PT course varies widely with a maximum of five years (with internship) to a minimum of 2 years. The diversity in PT education across the world is highlighted in Table 2.1 and the need for the highest standards of PT practice to be attained and maintained worldwide will be a challenge for the WCPT to oversee in the future.

2.2.4 Legal and Professional Considerations for Physiotherapy Practice in South Africa

In South Africa all practising physiotherapists are required to belong to and pay an annual professional fee to the Health Professions Council of South Africa (HPCSA, 2017). This professional body dictates PT educational requirements, codes of practice, deliberates on ethical concerns and is instrumental in dealing with malpractice complaints from the public. Physiotherapy practitioners can also choose to be a member of the official professional representative body namely the South African Society of Physiotherapy (SASP, 2017). The Society affords its members, directory registration, insurance cover, encourages and enables acquisition of Continuing Professional Development (CPD), gives deserving PT researchers grants via the South African Society of Physiotherapy Research Foundation and ensures the autonomous rights and identity of the profession (SASP, 2017). Under the SASP banner practitioners can also become a member of one of a large number of special interest groups (SASP, 2017). The SASP is affiliated to the WCPT and the World Health Organisaton (WHO) (Physiopedia, 2017). Different PT service delivery groups are found in the public, private and academic sectors (SASP, 2017). The private sector includes both hospital and outpatient care and physiotherapists can also work in schools, day care centres and nursing homes (SASP, 2017). The public sector is large and is depenent for funding on the country's health department (Physiopedia, 2017). This sector sees physiotherapists working in government hospitals, clinics and some special-needs schools (SASP, 2017). The exposure to the public sector affords physiotherapists an opportunity to work with a wide variety of conditions needing PT

treatment. During the degree programme students receive increasing supervised clinical exposure chronologically until in the fourth year students are participating in approximately 80% clinical practice (Physiopedia, 2017). After a student has completed the final year of their degree programme and graduated with a Bachelors degree (Physiopedia, 2017) they are required to serve a year in community service in a government hospital or clinic that can be located in an urban or rural setting. This public service year helps to garner clinical competency, allow for professional development and help the young physiotherapists to adapt to cultural diversity (Mostert-Wentzel, Frantz and van Rooijen, 2013). The community service is like an internship where the newly qualified physiotherapist practices under the watchful eye of a more senior physiotherapist or with a group of more experienced physiotherapists. The SASP also offers a 'buddy' system where qualified physiotherapists are paired with newly qualified physiotherapists who can contact the experienced practitioners for mentoring (Mostert-Wentzel, Frantz and van Rooijen, 2013). Often the community service young physiotherapists go through offers exposure to different aspects of PT and they might find a preference for one area of PT practice and then pursue a speciality in the following years. Some also move towards completing a master's degree and a subsequent doctorate. The private and public PT sectors are well subscribed in the main urban regions. Private PT treatment is costly and is paid using medical aid cover so it is only available to middle and upper income groups. Most of the South African population cannot afford private treatment and therefore see physiotherapists in the public sector. Physiotherapy practitioners have to be adaptable due to the cultural and language diversity of the population. The community service year experience often familiarises the recently qualified physiotherapist with this aspect of professional development (Mostert-Wentzel et al, Frantz and van Rooijen, 2013). The academic sector is responsible for the education of PT undergraduate and postgraduate students in eight Health Science Faculties scattered throughout the country but these are located in urban settings (Physiopedia, 2017).

2.2.5 The Argument for investigating the role of gross anatomy in Undergraduate Physiotherapy Education in South Africa

Gross anatomy may seem to be a small inclusion in the overall consideration for a PT curriculum but all of the lofty ideals of achieving high standards of autonomous professional competency and treating patients in the most clinically beneficial and safe manner is dependent on having a strong foundation of anatomical knowledge.

The scoping review that is to be presented in Chapter 3 of this thesis gives a clear indication of past and present gross anatomy education for the international

undergraduate (entry-level) PT student body and in so doing emphasises the necessity for quality gross anatomy programmes to be available to such students. The evidence showed that only two of the studies pertain to a gross anatomy intervention in South Africa and this outlines the dire need for more investigation and reportage regarding gross anatomy education for undergraduate PT students in this country. The national gross anatomy survey to be presented in Chapter 4 identifies the diversity of gross anatomy programmes offered to undergraduate PT students and underlines the need for a uniform curricular approach to be investigated to enable standardisation of the quality of PT gross anatomy knowledge in keeping with clinical requirements.

Furthermore, the value of the opinions of qualified physiotherapists as to what should be included in a gross anatomy curriculum for undergraduate PT students and the pedagogies that should be used to teach such a curriculum has been mentioned previously in this thesis and is important for the preparation of PT students for clinical practice. The opinions of qualified physiotherapists from various South African service sectors who took part in the Study 3 focus groups for this thesis will be presented in Chapter 5 of this thesis.

Section 3 consists of a presentation of learning styles and approaches that PT students can use to learn generally and in particular learn gross anatomy. Teaching styles are also described and the relevancy of matching teaching style to student learning style is discussed. This is pertinent to Paper 4 (Chapter 6) of this thesis.

2.3 SECTION 3: LEARNING STYLES, TEACHING STYLES AND THE RATIONALE FOR MATCHING THE TWO CONSTRUCTS

Many different learning styles and learning approaches have been described in the literature. Most of these constructs were developed to describe learning and teaching styles in non-health science scenarios. However, some valid conclusions have been drawn in relation to the learning of anatomy and the learning styles of health science students in relevant studies. There are also teaching styles that have been described (Grasha, 1994). It has been suggested that the recognition of the diversity of learning styles in a student population by educators will aid the learning process (Blackmore, 1996). This section will be subdivided to: introduce the Curry ‘onion-model’ concept, define learning styles and learning approaches; to give a brief history of the development of the types of learning styles and their characteristics with particular emphasis on the Grasha-Riechmann learning style approach used in Paper 4

(Chapter 6) of this thesis; to link the relevance of learning style choice to PT student learning of gross anatomy: to describe the Grasha-Riechmann teaching styles and to give the reasons for possible beneficial or detrimental outcomes resulting from the matching of such constructs.

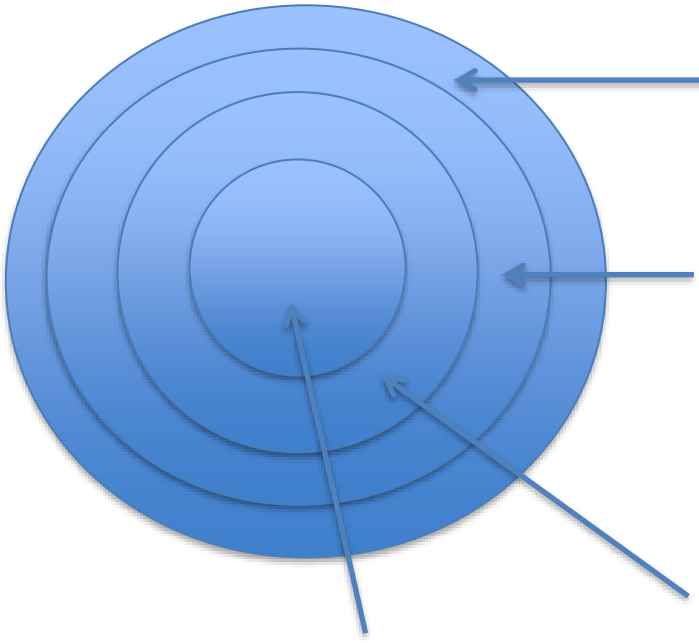
2.3.1 The Curry 'Onion-Model'

In 1983, Curry described a learning style organisational model that was depicted in a drawing of a three-tiered 'onion'. The three layers of this 'onion-model' represent basic behaviours that are automatic or perhaps even subconscious (Curry, 1983 cited in Cassidy, 2004). The outermost layer, termed the 'Instructional preference' layer is associated with the learning environment preferred by an individual. It is the least stable layer (Cassidy, 2004) and is associated with the Learning Preference Inventory (Rezler and Rezmovic, 1981). In 1987, a fourth layer, 'social interaction' was added to the Curry model and is positioned internal to the 'instructional preference' layer (Cassidy, 2004). The GRLSS is positioned in this layer that is most associated with the expectations of teachers and students and their interaction with the learning environment (Smith and Dalton, 2005; Cassidy, 2004; Curry, 1983 cited in Cassidy, 2004). Internal to the 'Social Interaction' layer is the 'Information processing style' layer and the central area is termed 'Cognitive personality style' (Figure 2.2).

Figure 2.2 illustrates the four-tiered version of the Curry 'onion' style model. Each of the layers is associated with particular learning style measurement tools. The 'Information Processing Style' layer is associated with Kolb's Learning Style Inventory (Kolb, 1976), the Cognitive Preference Inventory (Tamir and Cohen, 1980) and the Inventory of Learning Processes (Schmeck, Ribich and Ramaniah, 1977). The most central 'Cognitive Personality Style' layer is associated with the Embedded Figures Test (Witkin, 1962 cited in Cassidy, 2004), the Myers Briggs Type Indicator (Myers, 1962 cited in Cassidy, 2004) and the Matching Figures Test (Kagan, 1965 cited in Cassidy, 2004).

2.3.2 Learning Styles and Learning Approaches

Learning incorporates a process that involves a learner adapting to environmental stimuli on a mental, social and moral basis and in a holistic manner while looking towards the future (Curry, 1983 cited in Cassidy, 2004). Learning styles have been defined as the different roles that students develop to interact with peers, teachers and the content of their course (Rollins, 2015; Grasha and Riechmann-Hruska, 1996).



'Instructional preference' layer

1 Most observable
2 Very easily influenced
3 Least stable
4 Associated with Learning Preference Inventory

'Social interaction' layer

1 Preference for social interaction during learning
2 Associated with GRLSS

'Information processing style' layer

1. Intellectual approach to processing of information
2. Associated with Kolb's Learning Style Inventory
3. Cognitive Preference Inventory
4. Inventory of Learning Processes

'Cognitive Personality Style' Layer

1. Most robust style
2. Behaviour of an individual observed in varying learning scenarios
3. Associated with Embedded Figures Test
4. Myers Briggs Type Indicator
5. Matching Familiar Figures Test

Figure 2.2: Graphic Representation of Curry's Four-Tiered Extended 'Onion' Style Model (*adapted from Curry, 1987 cited in Cassidy, 2004*)

Furthermore, they are used intentionally and consciously by individuals to achieve well thought out goals (Curry, 2002). Learning style investigative psychology studies were fashionable in the 1960s and 1970s and arose because of an initial interest in individual learning style differences (Curry, 1983 cited in Cassidy, 2004). Curry (1983 cited in Cassidy, 2004) cautioned about using the term learning scale when discussing individual learning processes and cognitive approaches to learning. This author also felt that the term learning style was overused and should only be used to 'refer to the general area of interest concerning individual differences in cognitive approach and process of learning'. Unique learning styles formulated during childhood continue into adulthood (Chase, 2001). These styles have been described as being quite static and individualistic (Smith and Dalton, 2005). However, they may be influenced by changing circumstances related to the environment, the particular

learning task being addressed and the individual's perceptions of it (Smith and Kolb, 1986). These situational changes may lead to an alteration in learning style (Smith and Kolb, 1986). Student learning style preference can also be influenced by the subject to be learnt (Spoon and Schell, 1998; Sutcliffe, 1993).

All learning styles are present to different degrees within the psyche of a student but some are more dominant and are favoured over others (Grasha and Yangarber-Hicks, 2000). Some are present but unused and can come into play if sufficient reason and support is given (Kolb, 1984). Pertinent to the content of Paper 4 (Chapter 6) of this thesis it has been shown that particular learning style preferences are found in health science student groups (Linares, 1999; Kolb, 1984).

Similarly, learning approaches are rooted in the learning context and are influenced by it. They are relatively unfixed characteristics of the students' psyche, so can change easily to adapt to learning needs (Smith, Martinez-Álvarez, McHanwell, 2014). Two main approaches identified are 'surface learning' and 'deep learning' (Marton and Pong, 2005; Ramsden, 2003; Saljo, 1979). Surface learning incorporates repetitive learning and reproduction of facts and deep learning is related to understanding the content of the subject (Smith, Martinez-Álvarez and McHanwell, 2014). A number of international studies conclude that deep learning is most beneficial (Ward, 2011; Pandey and Zimitat, 2007; Smith and Mathias, 2007). A 2014 study reported that the 'deep learning' approach and the 'strategic learning 'approach were found in undergraduate anatomical learning (Smith, Martinez-Álvarez and McHanwell, 2014). Researchers in a Malaysian study found that when medical students adopted a Visual, Auditory, Read/Write, Kinaesthetic (VARK) read/write or kinaesthetic learning style they were more likely to use a deep approach to learning and consequently performed better academically (Kumar et al., 2012). Deep learning has been associated with the Grasha-Riechmann learning style scale (GRLSS) Collaborative and Competitive categories (Çolak, 2015) and Collaborative and Participant categories (Azarkhordad and Mehdinezhad, 2016). The Collaborative learning style can possibly be apportioned to team-based anatomy learning where PT students exhibited a positive response to anatomy (Livingston, Lundy and Harrington, 2014). Hawk and Shah (2007) stated that effectiveness of and quality of learning can be dependent on the learning approach or type of learning activity chosen and this is determined by the learning style of the student. Hence, the link between learning style and learning approach is established and may have a bearing on learning outcomes.

2.3.3 Learning Style Development and Characteristics of Specific Learning Styles

The first introduction of the concept of learning style was by Dunn in 1960 (Can, 2010). In the 1970s unique learning styles were noted in accordance with the way in which individuals handled tasks to be completed (Marton and Säljö, 1976; Pask, 1976). In fact Entwistle (1991) accredited the terms 'learning strategy' and 'learning style' to Pask. The afore-mentioned authors with the exception of Can (2010) reported that individuals motivate themselves to use learning styles to either use the information learned towards achieving something, to merely use it to get through an examination process or to understand it deeply. This work was further developed in Europe (Entwistle, 1981 cited in Curry, 2002) and in Australia (Biggs, 1987). In North America some researchers developed theories and research programmes based upon the earlier reported learning style constructs (Weinstein and Mayer, 1986 cited in Simsek and Balaban, 2010; Schmeck, 1988, 2000). Within medical education there has been acrimonious debate about the use and application of learning styles (Curry, 2002). In this regard originating in the 1970s two distinct categories of interest have been identified in medical education (Curry, 2002). The one aspect pertinent to Study 4 of this thesis is that where learning styles may be used at undergraduate level to raise educational productivity (Curry, 2002). The concepts of the way in which the theoretical paths and investigative processes have developed differ according to whether they originate from the North American or the Australian and European viewpoints. While the North American perspective deals with individual cognitive differences the European and Australian perspective addresses, by means of studying style differences, motivational variations. In the North American approach learning styles are related to personality traits or strategies used to process information. Conversely the European approach looks at how students undertake a task and the resultant ability to learn arising from the chosen approach (Newble and Entwistle, 1986).

Curry (2002) pointed out assertions regarding learning style factors reported in medical education literature available at that time. With regard to learning styles gender and age have an effect on them (Curry, 1991) and they differ with different medical specialities (Hilliard, 1995; Curry, 1991).

Many learning style models have been designed and utilised and as many as 71 have been identified (Coffield et al., 2004). It would be impossible to include a description of the many available models and measurement instruments in this thesis but it is possible to give a small overview of three that this researcher has found to be used to measure the learning styles of students in higher education or medical or allied health

studies. These have been linked to each other in some studies or to the deep and superficial learning approaches and in that way comparisons can be made between them. The first to be described is Kolb's model that gave rise to the Kolb Learning Style Inventory (KLSI).

2.3.3.1 The Kolb experiential learning styles model

The Kolb model, created in 1984, is based on experiential learning and is divided into two categories related to 'grasping experience' with the subdivisions 'concrete experience' (CE) and abstract conceptualization' (AC) and two categories related to 'transforming experience' with the subdivisions 'reflective observation' (RO) and 'active experimentation' (AE) (Kolb, Boyatzis and Mainemelis, 1999).

Figure 2.3 illustrates the modes of response to the demands of a situation that Kolb suggests should all be cyclically applied to produce effective learning. Individuals attempting to fulfil these criteria may show a preference for a combination of one 'grasping' and one 'transforming 'approach and this gives rise to categorisation into one of four learning styles (Kolb, Boyatzis and Mainemelis, 1999).

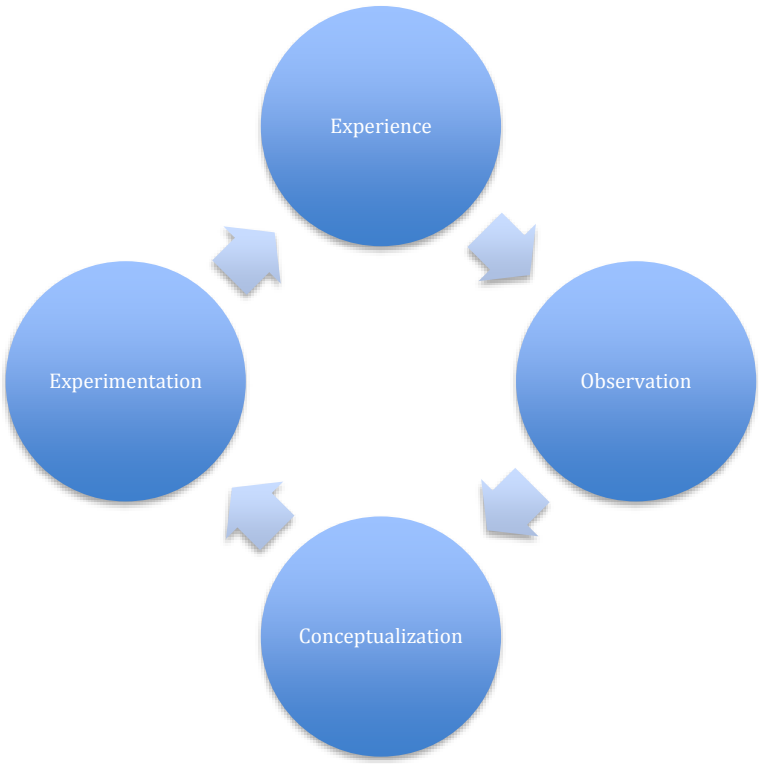


Figure 2.3: Modes Associated with Kolb's Related Approaches to Experiential Learning

Figure 2.4 illustrates the Kolb learning styles created by the combination of approaches. Each of the learning styles is associated with certain types of personality. The Accomodator style is associated with someone who is practically strong and ‘hands-on’ such as a physiotherapist. The Converger represents someone who is practically strong and ‘hands-on’ in theory application such as an engineer. The Diverger is strong in using their imagination and discussion such as a social worker and the Assimilator has strong inductive reasoning and can create theories skills associated with a philosopher (Kolb, Boyatzis and Mainemelis, 1999).

A study in higher education that used the KLSI found that undergraduate student learning styles mostly align with the Assimilator learning style (Yamazaki, Murphy and Puerta, 2002). When the learning styles of five allied health professional groups of students (nursing, PT, OT, physician assistant and speech therapy) were assessed using the KLSI it was reported that there was similarity in learning style for four of the groups (with a balance between learning styles being chosen). However, the PT group favoured the Converger category with strong leanings towards AE (Hauer, Straub and Wolf, 2005). When the learning styles of a diverse group of students enrolled in dietetics, midwifery, nutrition, nursing, OT, pharmacy, PT, paramedics, radiography and radiation therapy were tested using the KLSI, the health science students preferred the Converger style akin to the previous study’s findings for PT students and suggested that teachers of health science students should consider more problem solving activities in keeping with the dominant converger learning style (Zoghi et al., 2009). This study also reported that the Accommodator and Divergent categories were least popular with these students. Allied health students in the Middle East showed a preference for the AC area with the RO area also being popular with students other than PT students. These researchers concluded that the Assimilator learning style was the best fit for such students (Manee, Nadar and Jahrami, 2013). Interestingly the results presented in the three above studies differ with the suggestion that the Accomodator category is best suited to PT put forward by Kolb, Boyatzis and Mainemelis (1999).

2.3.3.2 **The VARK learning styles**

The VARK learning styles model attributed to Fleming was developed in 1987 (Cherry, 2017). It distinguishes four main types of learning styles: Visual learning where the student learns best by using diagrams, graphs, charts and other visual materials; Aural learning where the student learns best from hearing the information like in the lecture scenario; Reading/writing learning where the student benefits most from texts such as in books and Kinaesthetic learning where the student finds a

hands on approach and tactile approach to learning best (Cherry, 2017; Fleming, 1995).

Students often gravitate towards the method of learning that suits them best as far as understanding and retaining information is concerned. But sometimes they have no single learning preference and change their learning style according to the demands of the situation. In this case, they may exhibit a multi-modal style (Cherry, 2017; Fleming, 1995).

In a study to ascertain whether VARK learning style, career choice or time spent studying impacted on academic achievement in a combined anatomy and physiology course given to various allied health professions' students, it was found that the latter two factors had an association with better academic performance (Farkas, Mazurek and Marone. 2016). In similar studies where such students including PT students were assessed using the VARK inventory in all classes a majority of students exhibited multi-modal choice with kinaesthetic learning being chosen by a high proportion of the students (Good, Ramos and D'Amore, 2013; Brown, Cosgriff and French, 2008). In particular significant negative correlation for kinaesthetic preference was noted with human anatomy academic performance but the authors did point out that the assessment had been using the spot test type format where students were not allowed to touch specimens hence negating the impact of tactile input (Good, Ramos and D'Amore, 2013). A majority of undergraduate medical students were shown to display a preference for a multi-modal style of learning (69.9%) and 50% who only chose one VARK learning style opted for the auditory option (Samarakoon et al., 2013). When gender was factored into the VARK learning style equation it was seen that female students (56.7%) were marginally more multi-modally orientated than their male (56.1%) counterparts and these researchers alerted instructors to be aware of such differences and attune their teaching style accordingly (Slater, Lujan and DiCarlo, 2007). In a study where both the KLSI and the VARK inventory were used to assess OT students learning styles, the Divergent (30.2%) and the Converger (28.4%) options were the most popular. The VARK results showed a preference for the kinaesthetic style (33%) followed by a multi-modal (18.1%) (French, Cosgriff and Brown, 2007). Therefore, it appears that students following a medical or allied health sciences path are inclined to be adaptable and multi-modal in their approach to learning information. The VARK kinaesthetic approach is seen to be very popular with PT students. This approach is well suited to the use of dissection as a teaching method for gross anatomy and the 'hands on' nature of PT clinical practice.

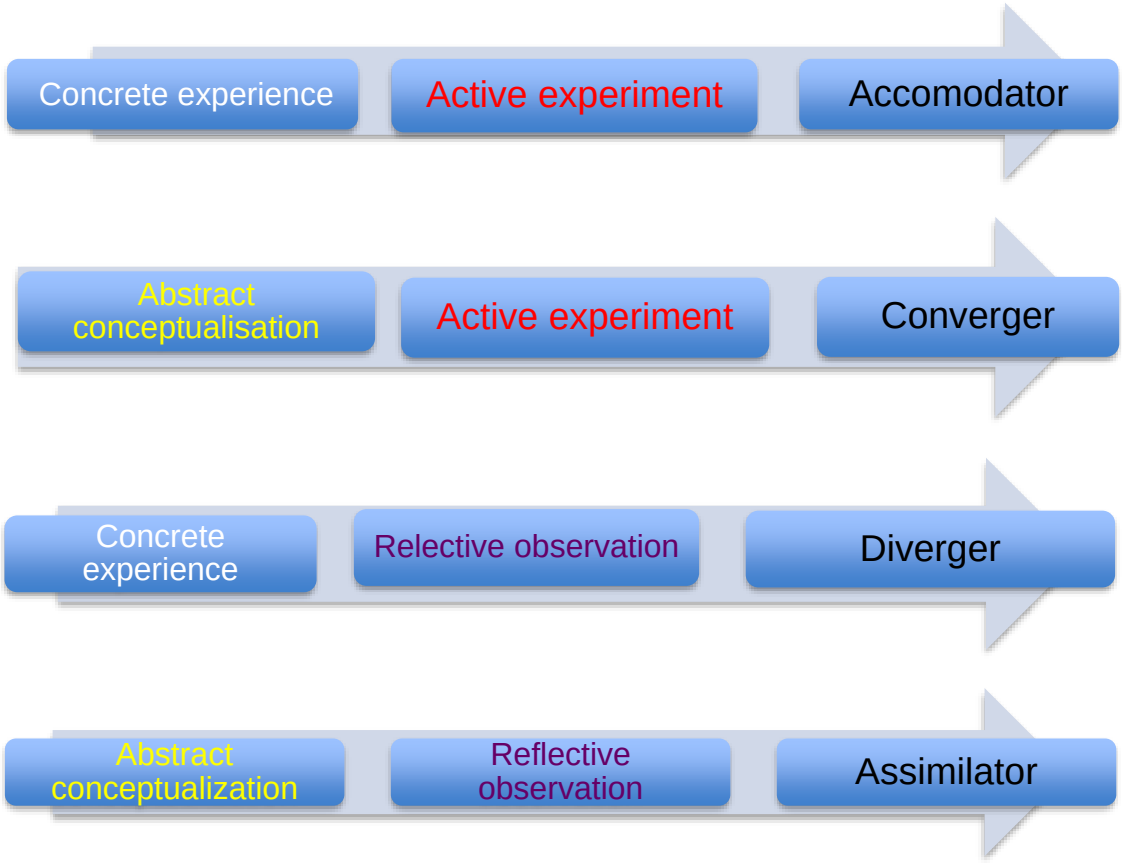


Figure 2.4: Kolb Learning Styles

2.3.3.3 **The Grasha-Riechmann Learning Styles Scale (GRLSS)**

The original GRLSS was developed in 1974 with three identified learning styles. These were cooperative, independent and dependent (Spoon and Schell, 1998). The first version of the GRLSS was designed to assess the classroom participation styles of American college students. The students' attitudes were compared to those of one of Grasha's colleagues who held traditional ideas. This comparative process resulted in the formation of the learning style categories. The adapted version of the scale was developed in 1996 and consists of a sixty-item questionnaire divided into six style categories namely: independent, avoidant, collaborative, dependent, competitive and participant (Baykul et al., 2010; Cassidy, 2004).

The GRLSS learning styles are described as:

Independent	:	Individualistic, confident and acting alone.
Avoidant	:	Avoiding participation and may be deemed unenthusiastic and disinterested. They may even not attend classes.
Collaborative	:	Being a group participant who likes to share ideas and works well with others.

Dependent : Someone who does not question and needs structure and constant support from lecturers and classmates.

Competitive : Someone who likes to outshine others, be recognised and get rewarded for achievements.

Participant : Taking part in class activities, working well with others and completing course work (Rollins, 2015; Grasha, 1996).

While there are numerous learning style models and measures (Lewis, 2014; Cassidy, 2004), there are few instruments designed specifically for assessing learning styles of students at the university level. The GRLSS fulfills the necessary criteria for this and so it was chosen as the measure for Paper 4 of this research and its use is described in Chapter 6 of this thesis (Rollins, 2015; Grasha and Yangarber-Hicks, 2000).

However, as previously stated the application of the GRLSS in studies dealing with health care students is limited. One such study used the GRLSS to assess he learning styles of pre-clinical medical students. The researchers found that the collaborative (40%) and competitive (27%) learning styles were the dominant choices by the students (Asci et al., 2016). In a study that compared the learning styles of second year pharmacy students before and after exposure to a one semester problem-based learning experience, it was found that the collaborative learning style was the most frequently chosen style overall. The researchers reported a significant increase in the avoidant category and significant decrease in the participant category between pre and post-intervention scores. However, they felt that the change to a problem based learning format from a didactic approach together with the introduction of team-based learning may have had an unsettling effect on the students and affected the post-intervention results (Novak et al., 2005).

One of areas of interest in the literature is the impact that age and/or gender has on GRLSS learning style choices. Before looking at examples of GRLSS studies that involved gender comparisons, it is appropriate to note that differences in ‘thinking’ have been apportioned to males and females. Perry (1999) studied undergraduate male college students and concluded that young men undergo developmental changes in thinking patterns. He identified nine stages to this process where males see answers as definitive, not unsolvable, believe everyone has a right to an opinion and act independently. Contrarily women were portrayed as being dependent, unable to create knowledge, working with intuition, organised in the way they collected and passed on knowledge and able to construct knowledge from subjective or objective

sources (Belenky et al., 1986). In a study of preclinical medical students the most frequently chosen learning styles was competitive (34.8%) closely followed by collaborative (33.7%). The researchers found that the attainment of passing marks and higher mean scores in the final exam were associated with those students with the competitive learning style. The female students that chose either of the two preferred learning styles attained higher marks than their male counterparts in end of block assessments and the researchers concluded that when students fall into either of these two learning style brackets the female students will achieve more academically (Kulac et al., 2015). When the learning styles of two groups of students from humanities and science respectively were compared the science students mean scores were significantly higher for the competitive, collaborative, participative and dependent learning styles. Furthermore, the female students had significantly higher means in the dependent, collaborative and participative categories than the male students. However, the male students' mean scores were higher than the female scores for the independent and avoidant styles (Baneshi, Tezerjani and Mokhtarpour, 2014). Dominant learning styles for female student teachers were recorded as competitive, dependent and collaborative and for male student teachers as collaborative, competitive and dependent. The authors draw attention to the fact that students study to obtain high marks and ratings and therefore the competitive style is brought into play. However, they conclude that while the competitive learning style may motivate students to try and succeed, quality learning requires that teaching methods address the collaborative and participant styles of learning (Azarkhordad and Mehdinezhad, 2016).

2.3.4 **Teaching Styles including the Grasha-Riechmann Teaching Style Scale (GRTSS)**

It is clear that learning styles are only one half of the student-teacher equation and consideration has to be given to whether the matching of learning and teaching styles is an exercise that will improve student academic achievement (Grasha, 1994). Teachers often have a preferred teaching style that creates a comfort zone especially if the teacher is under pressure to perform (Vaughn and Baker, 2001). Many teaching styles are available. Bibace et al. (1981) described teaching styles that would cater for students to move from teacher-based learning to student-based learning and named them assertive, collaborative, facilitative and suggestive. Fleming and Mills (1992) suggested four modalities that seemed to reflect teaching experiences according to the VARK methodology previously developed for learners. Grasha (1994) suggested and defined five types of teaching styles namely, expert, formal authority, personal model, facilitator and delegator. A study in Iran that used the

GRTSS to measure the teaching styles of medical lecturers found that academic personnel were more likely to fall into the expert category (Amini, Samani and Lotfi, 2012). Grasha (2002) further described four clusters of primary and secondary teaching style blends. In 1996, he suggested that teachers should vary their teaching style to accommodate the multiplicity of student learning styles in order to encourage a future sustained learning environment (Rollins, 2015; Grasha, 2002).

2.4 CONCLUSIONS TO THE LITERATURE REVIEW

2.4.1 Introduction

This literature review offers insight into the many facets of gross anatomy curricular and pedagogical considerations available to educators endeavouring to design a gross anatomy programme for undergraduate PT students. It incorporates literature pertinent to the aims and objectives of this thesis and in this regard has painted a picture of the profession of PT and has indicated why the learning of gross anatomy is integral and essential to safe clinical PT practice.

The definition given for gross anatomy explains that it incorporates the macroscopic study of human anatomy internally and externally. The historical perspective on the subject shows that gross anatomy has been included as a basic science subject in medical education from ancient times. In particular, it has been an inclusion in a South African physiotherapy course since the early 1900's. It has been described as the foundation of medical education.

2.4.2 Curricular Matters

The delivery of such a gross anatomy course to undergraduate PT students is dependent on an appropriate and relevant curriculum. This literature review delineates factors that impact upon the formation and delivery of such a curriculum that will lead to clinically safe and competent PT practitioners. Factors discussed include:

- How time constraints on gross anatomy education influence the delivery of the programme and how the effect of such reductions can be minimalised in order to still maximise beneficial learning outcomes.
- Whether standards of clinical competency are being impacted by such time constraints and possible resultant decreased anatomical knowledge.
- The choice of a regional, systemic or mixed curricular approach. This is debated in light of pedagogical choices, types of learning programmes incorporated into the course and dependence or independence of a particular student body.

- How financial constraints can lead to a decrease in suitably qualified staff to teach the programme and may also impact on cadaver procurement or purchase of other materials such as computers.
- Whether the procurement of cadavers for dissection or prosection can also be dependent on religious or cultural factors.
- How the retention of anatomical information can be facilitated by the way in which it is presented and taught during such a curriculum.

2.4.3 **Choice of Pedagogy**

The most appropriate choice for delivery of the curriculum based on pedagogy chosen to fulfil this function is discussed at length. The more traditional types of pedagogy such as dissection, prosection, surface anatomy and the use of plastinated specimens are presented. In this regard, in general, anatomists and healthcare professionals still favour the use of dissection. However, the incorporation of computer technology in recent years has led to the use of blended learning and asynchronous online discussion forums. Innovative pedagogy such as multi-modal learning, the use of QR codes and the use of an Audience Response System has resulted in reported beneficial outcomes. Most recently virtual reality with immersive learning and the use of 3D printing have been looked at as adjunct learning modalities.

2.4.4 **Types of Learning Programmes**

Problem-based and integrated learning are discussed at length especially in relation to the student-centred aspect of such programmes. There is debate as to whether these programmes are suited to the teaching of dependent (introverted) students. They seem better suited to the teaching of independent (extroverted) students. The literature also suggests that such programmes do not support the use of dissection but are well served using team-based learning scenarios.

2.4.5 **Inter-Professional Education**

The literature suggests that inter-professional learning is advantageous to PT students. This preference is related to the argument that as professional, clinical practitioners the PT students will work in healthcare team situations and the early undergraduate exposure to working with other healthcare disciplines will facilitate this experience.

2.4.6 Team-Based Learning and/or Peer Teaching

This literature review offers opinion and debate on the use of team-based learning. It illustrates that it has been successfully used in combination with problem-based learning and that it is often combined with peer teaching/tutoring/mentoring with successful outcomes related to examination scores and retention of anatomical knowledge.

2.4.7 Physiotherapy Practice

This literature review establishes the role of the physiotherapist as a global professional and clinical practitioner. It also identifies the autonomous nature of the South African physiotherapist. It links the nature of South African physiotherapy practice with the need for a gross anatomy foundation fit for the task of ensuring effective and safe clinical practice. The need for collaboration between developed countries and poorer countries to enable the formation of improved and relevant physiotherapy education is also identified. As stated in point 5.2 of these conclusions financial restrictions such as those found in poorer countries can factor into the choices of pedagogy and curriculum design of a gross anatomy programme.

2.4.8 Learning Styles of Physiotherapy Students and Teaching Styles of Their Lecturers

Finally, this review described various learning style models that could be considered for the collection of data on PT students' gross anatomy learning styles carried out in this thesis. It explained the reasoning behind the attaining of learning style profiles for PT students and the teaching styles of their lecturers in order to access compatibility between the two groups and possibly facilitate a better understanding of how such students can be taught to create beneficial learning outcomes.

Overall, this literature review has established a platform of knowledge for the presentation of the findings of this thesis in the following chapters of this thesis.

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Chapter 3 follows and is a scoping review of the available literature aimed at establishing the state of undergraduate PT gross anatomy education in the global context.

CHAPTER 3

This chapter includes the bibliographical details of Paper 1 (Appendix 1) and the complete original Paper 2.

3.1 PAPER 1

Shead D, Roos R, Olivier B, Ihunwo AO 2016 Gross Anatomy Curricula and Pedagogical Approaches for Undergraduate Physiotherapy Students: A Scoping Review Protocol *Joanna Briggs Institute (JBI) database of Systematic Reviews and Implementation Reports* 14(10): 98-104.

Bibliographical Details of Original Paper 1 (Appendix 1)

Title: Gross anatomy curricula and pedagogical approaches for undergraduate physiotherapy students: a scoping review protocol.

Authors: Dorothy Shead, Ronel Roos, Benita Olivier, Amadi O Ihunwo

Journal: Joanna Briggs Institute (JBI) database of Systematic Reviews and Implementation Reports

Journal Details: The JBI database of Systematic Reviews and Implementation Reports is an online peer-reviewed journal that publishes systematic review protocols, systematic reviews and implementation reports of healthcare research that followed the JBI methodology.

The JBI database of Systematic Reviews and Implementation Reports is indexed in:

- MEDLINE
- Embase
- Mosby's Index (Elsevier)
- CINAHL (EBSCO)

It is included in the SCOPUS 2018 list with an online ISSN: 2202- 4433
The Research Gate Impact Factor (2015) is 0.21

Abstract: This publication did not require an abstract to be written
Key Words: Anatomy, curriculum, pedagogy, physiotherapy, undergraduate

The formatting of the content of this thesis paper is aligned with the publication requirements of the specific journal.

3.2 ORIGINAL PAPER 2

Shead D, Roos R, Olivier B, Ihunwo AO Curricular and Pedagogical Aspects of Gross Anatomy Education for Undergraduate Physiotherapy Students: A Scoping Review.

Journal: Joanna Briggs Institute (JBI) database of Systematic Reviews and Implementation Reports

Journal Details: The JBI database of Systematic Reviews and Implementation Reports is an online peer-reviewed journal that publishes systematic review protocols, systematic reviews and implementation reports of healthcare research that followed the JBI methodology.

The JBI database of Systematic Reviews and Implementation Reports is indexed in:

- MEDLINE
- Embase
- Mosby's Index (Elsevier)
- CINAHL (EBSCO)

It is included in the SCOPUS 2018 list with an online ISSN: 2202- 4433

This paper is currently under review by the *Joanna Briggs Institute Database for Systematic Reviews and Implementation Reports*

The formatting of the content of this thesis paper is aligned with the publication requirements of the specific journal. The tables and figures have been numbered in accordance with the formatting of this thesis document and inserted at the relevant position in the paper.

3.2.1 Title: Curricular and Pedagogical Aspects of Gross Anatomy Education for Undergraduate Physiotherapy Students: A Scoping Review

Authors: Shead D, Roos R, Olivier B, Ihunwo AO

3.2.1.1 Abstract

Objective: To determine gross anatomy curriculum and pedagogy for undergraduate physiotherapy students by reviewing published and unpublished global literature and to document if variations in pedagogy and curricular design influence gross anatomy outcomes.

Introduction: Gross anatomy education is essential for physiotherapy students' preparation for safe clinical practice. Sparse and diverse information on the identified topic exists. A scoping review was necessary to map curricular designs and pedagogies already being used with regard to various anatomical outcomes for physiotherapy students.

Inclusion criteria: Because there was a paucity of information on the topic no limits were applied regarding language, duration of the database search and age of study participants. Studies had to include information on gross anatomy curricula or pedagogy for undergraduate physiotherapy students or include information from qualified physiotherapists or those teaching gross anatomy to physiotherapy students.

Methods: Included studies were mainly sourced from the EBSCO host (CINAHL, ERIC and MEDLINE), PubMed and Scopus databases. Perusal of reference lists directed further retrievals. Studies published from inception up to 20 March 2018 were included. Studies were identified and screened using a modified version of the PRISMA flow diagram. Methodology followed was aligned with that of the 2018 JBI guidelines for authors. Selected studies were charted according to a template drawn up in a published JBI scoping review protocol (DOI: 10.11124/JBISRIR-2016-003164).

Results: A total of 1241 papers were sourced. Fifty-one studies satisfied the inclusion criteria. The eight study categories identified according to main intervention type were: Curriculum, pedagogy and materials (n=14), computer-assisted learning (n=9), multimodal and blended learning (n=7), inter-professional education (n=7), peer teaching (n=5,), clinical input (n=4), ethical, professional and psychological matters (n=3) and team-based learning (n=2). Mean sample sizes varied from 216.9 ± 241.3 participants in the inter-professional category to 55.3 ±30.4 in the ethical, professional and psychological matters. Overall 26 studies (51.0%) included physiotherapy students or personnel in physiotherapy anatomy programmes exclusively in the sample. Other studies included participants from the physiotherapy

profession combined with other professions. Main student disciplines with physiotherapy students were: medical students (n=11,45.8%), occupational therapy students (n=8,33.%). Various studies gave calculable length of intervention in weeks (n=14, 27.5%) or hours (n=6, 11.8%) or both (n=19, 37.3%). Vast majority 41 (80.4%) were cross-sectional studies of which three were RCT studies (5.9%). Others were sequential explanatory mixed methods, ex post facto and observation path models. Key points raised were: value of teamwork and inter-professional collaboration; relevance of gross anatomy to physiotherapy; role of computer-assisted learning in anatomy education; team-based learning increases anatomy examination scores; peer teaching benefits; value of practical clinical interventions and early clinical exposure; enhancement of professional behaviours and improved student attitudes to ethics and the dignity of human life.

Conclusions: This scoping review of published and unpublished literature on the curricular and pedagogical options for gross anatomy education of undergraduate physiotherapy students revealed a multi-faceted topic with many types of interventions and outcomes recorded. It identified variations in pedagogies and curricular designs and their impact on gross anatomy education for this student body.

Keywords: Anatomy, curriculum, pedagogy, physiotherapy, undergraduate

3.2.1.2 Introduction

Gross anatomy is the study of the macro external and internal aspects of a human being. It defines the relationships between anatomical structures and the function of such structures.[1]A physiotherapy (PT) educational program includes an anatomical foundation under the life science banner. [2] Undergraduate PT students worldwide need to have a sound foundation in gross anatomy to equip them for safe and effective future clinical practice.[3] The new perspectives on the way in which gross anatomy is taught and the way in which it will be taught in the future have been brought about by curricular and pedagogical changes resulting from a decrease in time allocated to gross anatomy teaching. [4-6] The problems of fewer suitably qualified teachers together with financial constraints also play a part in making adequate anatomy education a challenging undertaking. [7-9]

The decrease in medically qualified anatomy teachers has raised the fear that this might result in the poor realization of the clinical viewpoint in anatomy education.[10] There is discussion about whether anatomy instructors should be pure anatomists or anatomically competent medical or PT clinicians. [11-13] In this regard in 2013 Reimer et al.[13] found a 20% drop in the numbers of anatomically competent PT instructors when their findings were compared to the 1994 findings of Mattingly and Barnes. [14]

And yet gross anatomy curricular design needs to be clinically relevant. [15] Sbayeh et al. [16] put forward that not only those teaching and learning anatomy should have a say in the curriculum but those that use anatomy clinically should be allowed to give input in this regard. Physiotherapy has a scope of practice and those in the profession are aware of the gross anatomy requirements to ensure clinical competency. Hence, it has been suggested that physiotherapists should have some say in the gross anatomy curriculum for PT students. [13,14,17] Furthermore, Moxham et al. [18] and Johnson et al. [19] suggest that anatomy education should be clinically relevant to prepare students for their role as future PT clinicians.

Matching gross anatomy education to student professional readiness for and clinical effectiveness in their future career is a critical challenge. [16] Prithishkumar and Holla [20] assessed early clinical exposure in PT students using vertical integration and ward visits to enhance neuro-anatomy learning. These researchers found positive outcomes in recall and understanding of this section of the anatomy curriculum. The use of gross anatomy to introduce ligament testing to first year PT students described by Janssen et al. [21] or vertical integration in gross anatomy for second year Doctor of physical therapy (DPT) students where they test certain upper limb and lower limb joint movements enhances clinical understanding of anatomy. [22]

It has become clear that gross anatomy courses for PT students should look to address the need to prepare the student for a role as part of an interdisciplinary clinical team. In a recent study by Luetmer et al. [23] ultrasound technology was used in an inter-professional intervention where medical and PT students interacted with each other to discuss clinical aspects of gross anatomy with beneficial outcomes. It has been shown that dissection for PT students has been used in combination with inter-professional education (IPE). [24-26] It has also been combined with team-based learning, [27,28] and computer assisted learning (CAL). [29-31] Thomas et al.[8] and Mitchell et al. [32] reported on IPE with CAL and prosections. In a blended learning scenario Ogard [33] investigated the use of video dissections and Green and Whitburn [34] and Green et al. [35] used interactive online videos. New technological developments have led to the increase in the use of computers, ipads and cellphones in anatomy teaching [36-38] with mixed outcomes reported. [36-38] Modern teaching strategies such as blended learning are being implemented globally. [33,34,39]

Team based learning is in line with the concept of problem-based learning where students work together in small groups during practical sessions. [27,28] Peer teaching reported by Wait et al. [40] and Youdas et al. [41,42] peer mentoring described by de

Oliveira et al. [43] and peer tutoring investigated by Lake [44] have all been found to be beneficial to anatomical learning outcomes in the PT student population.

After an initial search of selected databases in November 2015, performed in conjunction with the development of a JBI protocol, [3] it was quite apparent that the global literature available on the topic was limited, study designs were varied and outcomes measured diverse meaning the review would be broad in scope. Hence, as suggested by Arksey and O'Malley [45] a scoping review was deemed appropriate. The initial limited database search was conducted using the MEDLINE (PubMed) and Scopus databases. This search helped direct further data collection by identifying keywords or phrases relevant to a systematic search for literature. A comprehensive search of the *JBI Database for Systematic Reviews* and Implementation reports, Cochrane Database of Systematic Reviews, Academic Search Complete, CINAHL, Education Research Complete, ERIC, MEDLINE, PubMed and Scopus was undertaken in March 2016. Grey literature was sourced using the websites specified in the published scoping review protocol. [3] Papers identified for inclusion contained primary research on the topic. Accepted papers all referred to pedagogy and/ or curriculum matters associated with an undergraduate PT population learning gross anatomy. Further papers were sourced by perusal of reference lists. All sourced literature summaries were tabulated according to the 2016 published JBI protocol template. [3] A final check of the databases and other sources was carried out on 20 March 2018 prior to the reporting of the findings in this scoping review. During all searches no existing scoping reviews and systematic reviews were found. The scoping review of the topic was carried out in order to establish whether there are areas in which parity exists and also to perhaps identify areas where a systematic review can be carried out to clarify the topic further. Therefore, the objective of this scoping review was to collect and describe the available literature relating to curricular design and pedagogy used in undergraduate PT gross anatomy education.

3.2.1.3 **Review questions**

The review questions are as follows:

What is recorded in the literature relating to the curricular and pedagogical approaches being used to teach gross anatomy to undergraduate PT students?

How do variations in pedagogy and curricular design influence the outcomes of such gross anatomy education?

3.2.1.4 Methods

The methodology followed in performing this scoping review was aligned with that of the 2018 JBI guidelines for authors. [46] A scoping review protocol relating to the topic was published in JBI by Shead et al.[3]

Deviations from the published protocol

The comprehensive database search followed that described in the published scoping review protocol [3] with the addition of the *JBI Database for Systematic Reviews* and Implementation reports and Cochrane Database of Systematic Reviews. The use of 'Quick Response (QR) Codes' and the inclusion of measurement tools for assessment were added to the concepts of interest when the main study was performed. Therefore, this information was not included in the protocol.

Inclusion criteria

Types of participants

This scoping review considered studies which included undergraduate PT students enrolled in a gross anatomy course in a tertiary institution, gross anatomy instructors, PT lecturers or professional physiotherapists who have conducted or taken part in research on the topic of this scoping review.

Concept

The current concepts of interest relate to curricula and pedagogy available for the gross anatomy education of undergraduate PT students. Within the available literature identification of a number of different terms have been made pertaining to the overall concept. Below follows a non-exclusive list of potential topics that were considered for inclusion

Gross anatomy pedagogy including dissection, prosection, use of plastinated specimens, body painting, surface anatomy and muscle relationships in a spatial context.

Technological instruction including CAL with advanced 3D visual learning, use of QR codes and asynchronous online discussion forums.

Educational learning systems including: peer group mentoring/tutoring/teaching, vertical integration, IPE, problem-based learning and case-based learning.

Developments in curricular design for allied health students including PT students that may include a core curriculum.

Measurement tools used for assessment of certain outcomes included the Team Based Learning Student Assessment Instrument, Individual Readiness Test, Group Readiness Assurance Test, Readiness for Inter-professional Learning Scale and Interdisciplinary Education Perception Scale.

Outcomes measured resulting from gross anatomy pedagogy and curricular changes for the undergraduate PT student population.

Context

The review gathered data in a global setting. It was conducted using information gleaned from the available literature that looked at gross anatomy programmes for undergraduate PT students studying at universities.

Types of studies

All available quantitative descriptive studies, qualitative papers, mixed methods studies, descriptive studies, randomized controlled trial (RCT), systematic reviews, meta-analyses and conference papers or abstracts from such papers on the gross anatomy curriculum and pedagogy for undergraduate PT students were eligible for inclusion.

3.2.1.5 **Search strategy**

The search for studies was open-ended concomitant upon the fact of a paucity of specific information on the topic exclusively pertaining to undergraduate PT students. A three-step search strategy was used in this review. An initial limited search was conducted using the MEDLINE, PubMed and Scopus databases. An analysis of the retrieved titles and abstracts was then undertaken to identify key words and index terms used to describe the articles. Secondly, a search using all the identified keywords and index terms was undertaken across all included databases namely: *JBI Database for Systematic Reviews* and Implementation reports, Cochrane Database of Systematic Reviews, Academic Search Complete, CINAHL, Education Research Complete, ERIC, MEDLINE, PubMed and Scopus (Appendix 1). The grey literature was sourced using Google Scholar, EBSCO Host, the Anatomical Society of Southern Africa (ASSA) web site and a search for theses on the topic was conducted using a tertiary institution’s library resources. Published and unpublished studies in all languages dated prior to 20 March 2018 were considered for inclusion. The reference

lists of the collected studies were perused to identify additional studies. There was no need to contact authors of primary studies for further information. Identified papers were subjected to an assessment process that incorporated screening of the papers, a decision on the eligibility of the paper and recording of its inclusion in the study. This was carried out using a PRISMA Flow Diagram as suggested by Moher et al. [47] but the process was modified in keeping with the scoping review format. Figure 3.1 represents the modified PRISMA Flow Diagram of the study.

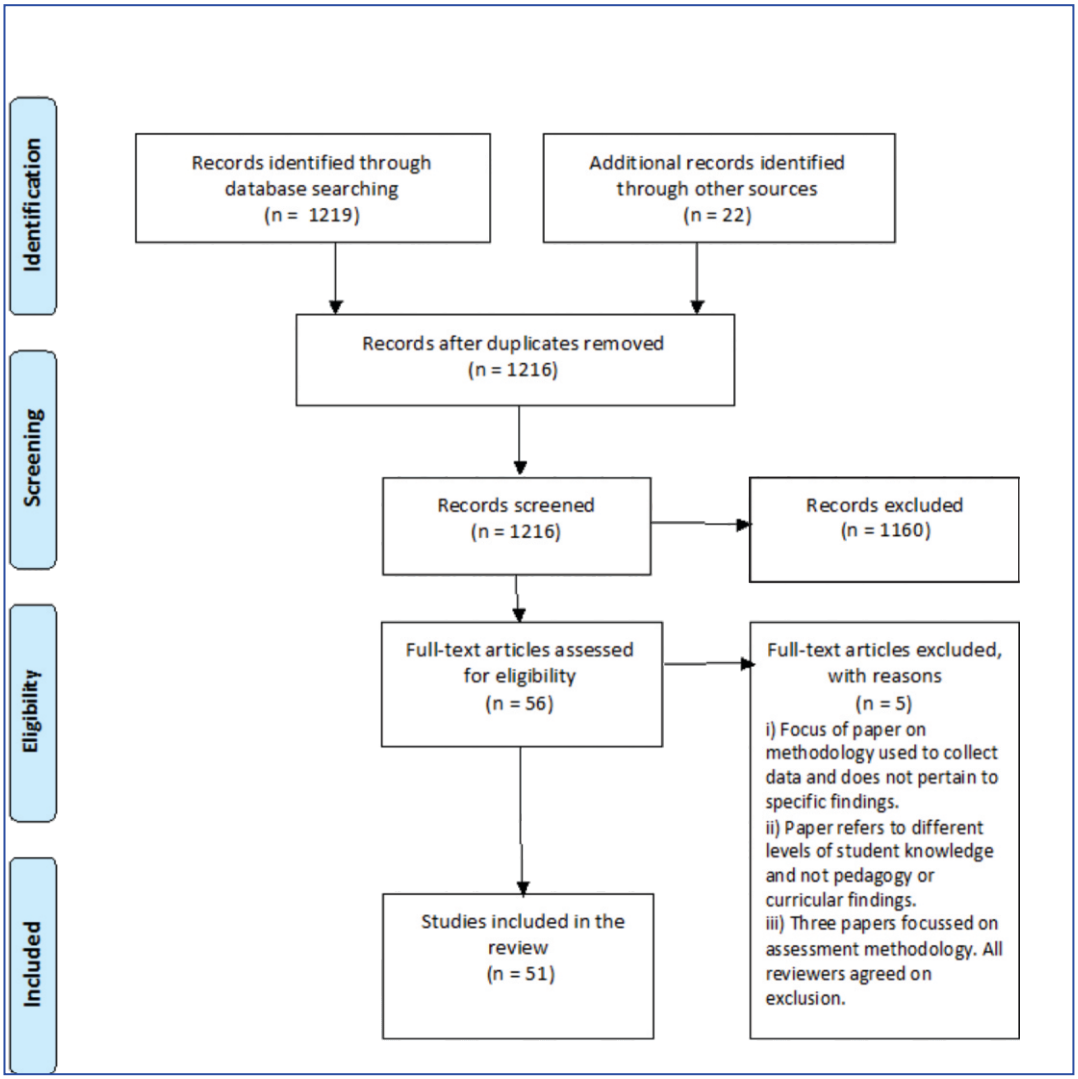


Figure 3.1: Modified PRISMA Flow Diagram of Eligible Scoping Review Papers (*Moher et al, 2009*)

3.2.1.6 **Study selection**

As this was a scoping review no assessment of methodological quality was performed. Two independent reviewers (DS and RR) initially decided whether a study should be considered for inclusion based on the information reported in the abstract. A meeting was held to compare the results of this process, reach

conclusions and plan the way forward. The accepted studies were then subjected to a process whereby the two reviewers accessed the documents independently to ascertain whether the studies conformed to the research design. Another meeting was held to discuss the results of this stage of the review process and to debate inclusion of papers. When the two reviewers could not reach consensus on the inclusion of certain studies, the third independent reviewer (BO) was called upon to resolve the matter.

3.2.1.7 **Data extraction**

The two independent reviewers extracted data (qualitative and quantitative) from each study relevant to the review question. Reviewers recorded the key information of the source relevant to the review question by means of charting. A data extraction instrument for the scoping review charting was developed in the JBI protocol document[3] prior to the second phase of data collection and it was further modified at the review stage. The two main reviewers tested the charting format with three studies to check whether it was fit for purpose and found it to be correct.

3.2.1.8 **Charting the results**

The afore-mentioned JBI scoping review methodology was used to map the results into eight categories according to main intervention type. The initial headings used in the charting tables were as per the scoping review protocol [3] and then the results and conclusions were combined to present the key findings of each study. As per the format of a scoping review the process was a continuous one and data were collected, independently reviewed and accessed as they became available over the duration of the study.

3.2.1.9 **The results**

The results are divided into eight main categories and are grouped accordingly (Figure 3.2). Some studies include two or more types of anatomy intervention, embrace two or more learning concepts or describe varied aspects of gross anatomy education for PT students but the primary nature of the intervention dictated the way in which they were assessed. All of the categories related to international undergraduate physiotherapy gross anatomy education. They can be listed as:

- IPE
- CAL
- Blended and multi-modal learning
- Team-based learning
- Peer teaching

- Pedagogy, curriculum and materials used
- Clinical input in a gross anatomy curriculum, case-based teaching and vertical integration
- Ethical, professional and psychological matters

Table 3.1: Descriptive Statistics of Included Studies

Intervention type	Range of years of publications	Range of sample size	Average population/sample size: mean (± SD)	Average duration of intervention			
				Weeks		Hours	
				Range	Mean (± SD)	Range	Mean (± SD)
Inter-professional education	2004-2018	70-720	216.9 (± 241.3)	0-10	2.3 (± 4.1)	0-30	7.6 (± 11.2)
Computer assisted learning	1992-2011	28-162	80.0 (± 46.8)	0-15	5.4 (± 6.4)	0-180	38.0 (± 68.3)
Blended and multimodal learning	2013-2017	44-500	212.6 (± 187.0)	0-24	9.1 (± 9.1)	0-140	38.3 (± 61.2)
Team based learning	2014-2015	85-212	148.5 (± 89.8)	15-45	30.0 (± 21.2)	30-135	82.5 (± 74.2)
Peer teaching	1999-2015	32-146	75.4 (± 52.6)	10-45	19.0 (± 14.6)	17.5-135	63.5 (± 61.3)
Pedagogy, curriculum and materials	1980-2018	9-500	141.9 (± 122.6)	0-40	8.5 (± 14.0)	0-0.7	0.05 (± 0.2)
Clinical input	2011-2014	20-225	72.8 (± 101.5)	0-1	0.75 (± 0.50)	0-4	1.7 (± 1.9)
Ethical, professional and psychological	2009-2013	28-88	55.3 (± 30.4)	0-4	1.7 (± 2.1)	0-6	2.1 (± 3.4)

SD: Standard Deviation

3.2.1.10 **Range of years of publications**

Table 3.1 illustrates that studies on pedagogy and curricular matters have spanned the greatest number of years. According to the findings blended learning and multimodal learning are recent innervations being researched and there is a move towards IPE also being increasingly investigated in the last 14 years. Computer assisted learning was well researched until 2011. However, the advent of the blended learning approach has possibly led to a decrease in studies on pure CAL interventions as can be seen by the fact that six blended learning studies have taken place in the last four years.

3.2.1.11 **Sample size and sample characteristics.**

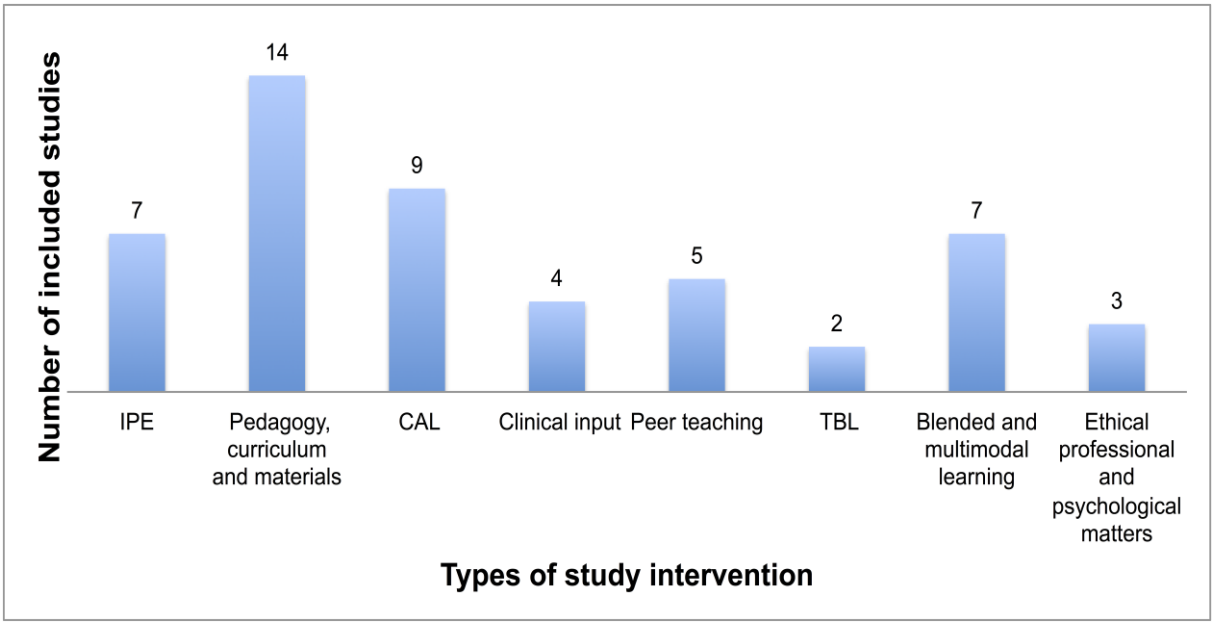
The average sample sizes were largest for the studies in the IPE category (216.9 ± 241.3) and the multimodal and blended learning category (212.6 (±187.0) although each category only contained n=7 (13.7%) studies (Table 3.1). This table also shows that the smallest average sample size for listed studies is in the category of ethical, professional and psychological matters (55.3 ±30.4) where n=3 (5.9%). A calculation of whether sample sizes were composed of only PT students or were made up of mixed student disciplines revealed that overall 26 studies (51.0%) had PT students or PT personnel in PT anatomy programmes exclusively in the sample and 24 studies (47.1%) had mixed student disciplines. Of the 24 studies with mixed student groups the majority of students in studies with PT students were medical students n=11 (45.8%) studies followed by occupational therapy students n=8 (33%) studies. Other disciplines represented were diverse and included physician assistants, nursing, radiology, nutrition and dental students. A majority of samples in the blended and multimodal learning studies n=4 (57.1%) were made up of only PT students. The range of sample sizes in the IPE and pedagogy, curriculum and materials categories had high upper markers of 720 and 500, respectively. In the case of the IPE studies it is possibly because, by their nature, such studies have large interdisciplinary sample sizes. In the case of the pedagogy, curriculum and materials category it might be due to the fact that nine surveys were carried out in this category with extensive sampling in most of them.

3.2.1.12 **Average duration of intervention**

Duration of the intervention was impossible to calculate in some instances as no information was given at all (n=12, 23.5%). Hence, in almost a quarter of the studies gauging whether the length of the intervention was relevant was impossible as the time factor was omitted or was incalculable. It was noted that in the clinical input category interventions were of a short duration. However, the shortest reported

intervention lasted only 10 minutes and was in relation to the assessment of PT students' professional behaviour in the ethical, professional and psychological matters category.

Table 3.1 illustrates the average time spent in the intervention phase of the research in each study where it was calculable. The results were analyzed according to intervention duration in hours and/or weeks. Studies gave the length of the intervention in weeks (n=14, 27.5%), in hours (n=6, 11.8%) or in both weeks and hours (n=19, 37.3%). Most hours for an intervention per week are allocated to CAL studies.



IPE: Interprofessional education, CAL: Computer-assited learning, TBL: Team-based learning

Figure 3.2: Number of Studies Allocated to Each Category by Intervention Type

Figure 3.2 illustrates that the majority of the studies sourced were related to pedagogy, curriculum and materials (n=14) and CAL (n=10) and the least dealt with ethical, professional and psychological matters (n=3). The blended learning approach is currently being investigated as a possible solution to the dilemma of decreasing anatomy hours and so it is a popular topic for research as shown by five recent studies being sourced. Although only two studies are subscribed to team-based learning as an entity, studies such as those for peer teaching and IPE often include the group dynamic in their make-up. As previously stated there are areas of overlap pertaining to two or more learning methodologies in some of the 51 sourced studies.

3.2.1.13 **Study designs**

Of the 51 studies (100%) the vast majority of 41 (80.4%) were cross-sectional studies. Of these three were pilot studies. There were three RCTs (5.9%) of which two were run in conjunction with cross-sectional studies. Other types of individual study designs were sequential explanatory mixed methods, ex post facto and observation with path models.

3.2.1.14 **Charting of results**

Tables 3.2 to 3.9 chart, describe and summarize the 51 included articles under the eight identified categories.

Table 3.2: Charting Table Category 1: Studies of Inter-Professional Education (IPE) in Gross Anatomy for Undergraduate Physiotherapy (PT) Students

IPE Studies (n=7)	Study design	Location	Aims/purpose of included studies	Methodology of included studies	Key findings across studies
Luetmer et al. 2018 [23]	Cross-sectional, observational	USA	To increase musculoskeletal anatomical knowledge using ultrasound technology in a modified IPE intervention.	Student readiness for IPE checked in three studies (iRAT).	Ultrasound imaging and other methods of facilitating anatomy learning may be a successful way to teach anatomy.
Meyer et al. 2017 [48]	Cross-sectional, observational	Germany and Switzerland	To determine the effectiveness of a new IPE approach to learning of the knee joint.	Anatomical structures were palpated (physiotherapy station); orthopedic clinical tests were undertaken; clinical cases were described (orthopedic station). A discussion was held regarding the pathology of damage to the knee joint followed by a demonstration of biomechanical aspects of prepared joints.	Teamwork and collaboration rated highly. Belief that IPE would help teamwork in the clinical years ahead.
Sytsma et al. 2015[25]	Cross-sectional, observational	USA	To describe an IPE intervention and assess the long-term effect of such an intervention	Students divided into 5 mixed inter-disciplinary dissection teams. PT students taught upper limb to MD students and MD students taught heart and lungs to PT students. Clinical problem solving sessions took place.	Subscale analysis showed students enjoyed IPE. RIPLS: PI: 'Team dynamic needs trust and respect': agreement was reached with MD: 4.54 (± 4.54), PT 4.72 (± 0.60). Post intervention: 'Roles and responsibility': MD 2.82 (± 0.93), PT 1.92 (± 0.61), P< 0.001** Two main qualitative themes were identified: Appreciation for the opportunity to meet and work with students from another programme and increased understanding of the other group's professional role.

IPE Studies (n=7)	Study design	Location	Aims/purpose of included studies	Methodology of included studies	Key findings across studies
Fernandes et al. 2015 [24]	Sequential explanatory, mixed methods	Canada	To describe an IPE intervention and assess the long-term effect of such an intervention	To determine effect of IPE on perceptions and attitudes of healthcare students. This study used the RIPLS and the IEPS to measure student readiness for the intervention and their perceptions when working with other professional student disciplines.	Significant results were: RIPLS: 'Teamwork and collaboration': PI: 4.54 (±0.41), PSI: 4.68 (± 0.34), P<0.05* 'Positive professional identity': PI: 4.37 (± 0.52), PSI: 4.53 (± 0.50), P<0.05* 'Roles and responsibilities': PI: 2.30 (± 0.74), PSI: 2.11 (± 0.65), P<0.05* IEPS: 'Perception of actual cooperation': PI: 5.15 (±0.52), PSI: 5.30 (±0.53), P<0.05* Competency and autonomy': PI: 4.97 (±0.80), PSI: 5.28 (±0.66), P<0.05* Four main themes identified: Learning about self and others, learning about anatomy, experiencing the benefits of a longer duration IPE initiative and IPE interaction going forward.
Shields et al. 2015 [50]	Cross –sectional, descriptive	USA	To describe the degree of student satisfaction with a near-peer IPE intervention.	10 DPT peer teachers prepared a 30-minute presentation on the shoulder joint including palpation of joint and associated muscles, review of basic shoulder movements, muscle testing techniques, relationship between posture and shoulder movements and a clinical presentation on rotator cuff injury.	Medical students found being taught the shoulder joint by DPT students very beneficial. They felt that DPT students should teach them other joints. DPT students were satisfied with their presentation. Overall both student populations reacted positively to the IPE intervention (a <4Likert response was obtained), wanted more IPE sessions and felt the IPE session should have been longer.

IPE Studies (n=7)	Study design	Location	Aims/purpose of included studies	Methodology of included studies	Key findings across studies
Hamilton et al. 2015[26]	Cross-sectional observational	USA	To evaluate students' attitudes towards the effectiveness of an IPE intervention	Two IPE sessions of lectures and dissection. Clinical emphasis made for both student disciplines. Towards end of session self-revision occurred using multiple-choice questions.	Results were based on a survey. For 'it is not necessary for healthcare students to learn together' mean scores were: MD 1.87 (± 0.98), DPT1.52 (±0.57) P=0.022* For ' the function of physical therapists is mainly to supply support for doctors' MD 2.01 (± 1.18), DPT 1.46 (± 0.63), P=0.022* For ' shared learning with other healthcare students will increase my ability to understand clinical problems' MD 4.10 (± 0.91), DPT 4.48 (±0.54) P<0.001** 92% of students felt that it would improve interaction with other healthcare professionals going forward.
Mitchell et al. 2004 [32]	Cross-sectional, observational	UK	To assess students' attitudes to cadavers and to learning in IPE groups. To compare anatomy scores of students in IPE study.	Students were taught using lectures, computer assisted instruction and practical sessions with the application of clinical skills and problem solving being some of the topics covered. In the dissecting room students were randomly allocated within multi-professional groups to a prosected cadaver.	Results pertaining particularly to PT students: Smell in the dissecting room was very unpleasant to the PT groups (P=0.017)*. PT students' valued gross anatomy as most relevant to their discipline. Examination marks: PT students attained the highest average percentage (62.8%).

DPT: Doctor of physical therapy, IEPS: Interdisciplinary Education Perception Scale, IPE: Inter-professional education, iRAT: Individual Readiness Assurance Test, MD: Medical PBL: Problem-based learning, PT: Physical therapy/physiotherapy, RIPLS: Readiness for Inter-professional Learning Scale, UK: United Kingdom, USA: United States of America

Table 3.3: Charting Table Category 2: Studies of Computer-Assisted Learning (CAL) in Gross Anatomy for Undergraduate Physiotherapy (PT) Students

CAL Studies (n=9)	Study design	Location	Aims/purpose of included studies	Methodology of included studies	Key findings across studies
Thomas et al. 2011 [8]	Cross-sectional, observational pilot	USA	To ascertain the perceptions of DPT students about CAL and prosection and to compare anatomy knowledge of DPT students taught traditionally with those taught with CAL and prosections.	Students placed into small 4-5 student prosection groups. Visited 8 prosection stations.to observe prosected cadavers. Had supplementary tutorials, videos and CAL. Had pre and post-intervention tests.	After prosection with CAL there was a significant improvement (P< 0.001) in naming and drawing major anatomical structures from memory and in DPT student's ability to explain major anatomical relationships from memory. The 'hands on 'experience resulted in significant increase (P< 0.05) in student's ability to learn anatomy and decreased favorability of using lectures in place of prosection and CAL. Intervention groups' mean scores improved in two consecutive research years. CAL is a useful cost-effective adjunct pedagogy.
Plack 2000 [30]	Ex post facio	USA	To compare anatomy knowledge of DPT students taught traditionally with those taught with CAL and prosections.	Traditional MPT student group had lecture and dissection in groups of five. Intervention group had CAL and prosections.	Study with MPT students found CAL is as effective for gross anatomy teaching as traditional pedagogy.
McKeough and Bagatell 2009 [72]	Cross-sectional, observational	USA	To access students' attitudes to learning neuro-anatomy using CAL.	Had neuro-anatomy lectures and CAL modules observed by students.	Qualitatively: Main themes: Helped review information, reinforced neuro-anatomical ideas, helped with visualization, neuroanatomical concepts were learnt, clinical skills were learnt, clinical concepts were reinforced.
Foreman et al. 2005 [52]	Cross-sectional, observational	USA	To evaluate the use of a web-based CAL tool in neuro-anatomy and compare it to traditional learning tools.	CAL tool customized for anatomy programme. Students able to alter magnification and navigability of tool.	Using CAL to teach neuro-anatomy produced clinical self-efficacy. CAL tool helpful with structure identification (84%), somewhat better than traditional tools (95%) and beneficial overall (88%).
Bukowski 2002 [29]	Cross-sectional, observational	USA	To assess whether CAL competency influenced outcomes. To compare examination scores of PT students using CAL and those using traditional tools.	CAL competency assessed prior to intervention. Mean course marks per groups measured.	Higher computer competency was an advantage. Mean course marks between groups did not show significant difference. Self-study using CAL might be a viable alternative to traditional anatomy techniques. A blend of traditional lectures and CAL was found to be most beneficial to anatomy learning.

CAL Studies (n=9)	Study design	Location	Aims/purpose of included studies	Methodology of included studies	Key findings across studies
Anderson and Conley 2000 [51]	Cross-sectional, observational	USA	To compare anatomy retention in PT students using CAL and anatomical models to findings in the literature for the same type of intervention	Use of Animated Dissection of Anatomy for Medicine (ADAM) computer software and anatomical models.	After a CAL (ADAM), anatomical models, videos, radiographs, lecture and surface anatomy intervention test scores for anatomy retention were significantly better (P<0.01). Significant correlation (r= 0.59, P< 0.001) found between final course grades, final examinations scores (r=0.42, P<0.03) and post intervention scores. Anatomy knowledge was retained after six months and a year. Most anatomy retention after a year was in '"spine and back'" "spinal cord and peripheral nervous system" and "pelvic wall and viscera".
Berube et al. 1999 [31]	Cross-sectional, observational	USA	To ascertain opinions and trends regarding CAL and cadavers for PT students.	A survey instrument was designed, reviewed and emailed to primary instructors of anatomy for undergraduate PT students. It consisted of a demographic section, a section on anatomy class details, laboratory factors and student body factors. The third section had questions on anatomy pedagogy, student ratios and time spent in dissection per week	A PT degree was held by 42.7% of anatomy instructor respondents and 78% of instructors had doctorates. Teaching experience fell mainly between 16-20 years (15.9%). Cadavers were used in 92 % of programmes, 96.4% felt their use was "very effective" and 99% preferred cadavers to CAL. Ratio of students to cadavers varied from 1:4 (31.4%), 1:5 (17.1%), 1:6 (15.2%) to 1:8 (14.3%). Average length of time students used practical laboratories ranged from 97 -168 hours. Lectures were used for 10%-75% of programme time. Surface anatomy and PBL was found in 5%- 90% of programmes. Computers were used to some extent in 60.9% of programmes and 96.9% did not think CAL as effective as cadaver use to teach anatomy.
Jansen et al. 1996 [21]	Cross-sectional, observational	USA	To investigate customization of CAL software for allied healthcare students.	Class notes were converted into a multimedia lecture format. Animated videos and still images of prosections were given to students.	Interactive questions allowed students to assess performance and instructors to gauge progress. Students preferred the customized software for ease of use and as an effective learning tool as it helped with lecture and practical performance.
Lee and Allison, 1992 [71]	Randomized controlled trial	Australia	To prove ICAL could replace lectures and investigate whether it is effective in anatomical learning.	ICAL package made.120 features of lower limb surface anatomy identified, listed and added to ICAL format.	The use of an ICAL intervention was deemed feasible by the researchers. If theoretical 2D component of course was well learnt it could be efficiently applied on a 3D surface.

ADAM: Animated Dissection of Anatomy, CAL: Computer-assisted learning, DPT: Doctor of physical therapy, ICAL: Independent computer-assisted learning, 2D: Two dimensional, 3D: Three dimensional, MPT: Master of physical therapy, PBL: Problem-based learning, PT: Physical therapy/ physiotherapy, USA: United States of America.

Table 3.4: Charting table category 3: Studies of Multi-Modal and Blended Learning in Gross Anatomy for Undergraduate PT Students

Studies (n=7)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Langfield et al. 2017 [112]	Cross-sectional, observational	Australia	To investigate whether instructional, online videos improve performance of allied health students during practical anatomy examinations when related to students' anatomy self-efficacy.	Sixteen anatomy instructional videos were created. Students accessed 15 of them prior to the relevant practical session on a specific region. Video content related to specimens in the gross anatomy laboratory. Students were guided to the correct specimen and used the video on their "smart" device to orientate to structures on the specimen or could self-test on content.	Regarding video viewing: the most viewed region was the pectoral girdle (4.6 ± 0.4). Significantly the number of video viewings related to lower levels of self-efficacy scores. The 2014 upper limb regional anatomy test results (with videos) (55.8 ± 1.11) were significantly lower than those for 2013 (no videos)(69.1 ±1.25). Practical examination scores showed that although overall mean marks were decreased for the upper limb region a subset of students did perform better after viewing the videos.
Nicholson et al. 2016 [83]	Cohort study with observational design	Australia	To determine whether an interactive, multi-modal anatomy workshop improves academic performance.	The multimodal workshop consisted of 4 interventions: Body painting, white boarding, clay modeling and quizzes. Pilot study conducted to assess content, practical aspects and student's preference for certain learning styles.	Self-identified learning styles for workshop attendees showed a large preference for a combination of VARK model V and K (65%) learning styles. Attendees of the workshop improved their average mid-semester and end-semester examination results. Results of attendees were better than those of non-attendees. There was a significant ($P<0.001$) increase in perceived confidence ratings between the pre- and post-workshop surveys. Majority of students (84.8%) found the workshop helped examination preparation and improved academic performance. Five learning goal themes were identified in descending order: "understanding content", "strategic engagement with content", "examination preparation", "memorization of content", "increased self-confidence". Five main themes were identified regarding most useful aspects of the workshop: "body painting/clay modeling", "tables and schematic drawings and quizzes", "white-boarding", "group discussion/peer teaching" and "academic staff supervision" listed in descending order.

Studies (n=7)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Green et al. 2017 [35]	Cohort study	Australia	To describe a blended methodology for the delivery of a gross anatomy programme and evaluate outcomes for PT students.	Cohort studies (2015, 2016) used a 12-week blended learning strategy. Three spot tests and final written examinations.	Study found that the amount of engagement that a student had with online videos and increased participation in discussion forums had a positive effect on their learning outcomes.
Green and Whitburn 2016 [34]	Cohort study	Australia	To analyze and evaluate the use of asynchronous online discussion forums in a blended learning model in gross anatomy for undergraduate PT students.	Cohort study over 3 years on two campuses simultaneously. Anatomy education with progressive introduction of more online interactive video content into traditional format.	Results showed the intervention resulted in higher mean scores. In the first year mean postings on asynchronous discussion forums was higher than in the last year. Students found amount of work required when using the online interactive videos was appropriate in first two years but less appropriate in the final year. Major themes identified were: 'Wet (cadaver) laboratories", "staff'", "subject content/structure", "clinical anatomy classes" and "resources". The first four themes were identified as most useful to learning. Students found online videos did not cover content adequately. Positively, students could work independently and flexibly.
Green et al. 2014 [78]	Observational incorporating a path model	Australia	To evaluate whether PT student engagement with online videos and use of online discussion forums has a positive effect on their learning outcomes	Concept of asynchronous online discussion forums was introduced to students. They were encouraged to post new threads to complete course objectives answer questions posted by other students and/or post their own questions. Course coordinator moderated the forum site.	Percentage of students posting online in an asynchronous discussion forum was 48%. Mean course marks relative to the number of postings were: zero 60.5%, moderate 66.1% and high 73%. Higher number of postings by a student = higher final examination marks.
Green and Hughes 2013 [77]	Blended learning design	Australia			
Ogard 2014 [33]	Descriptive, cross-sectional study	USA	To describe the introduction of video dissections to decrease time spent on dissection and to see the impact of the intervention on course scores. To report on PT student's impressions of the anatomy course curriculum.	Video dissections were introduced into the gross anatomy curriculum to reduce cadaveric dissection time. Video dissections were viewed online during anatomy sessions.	When cadaveric dissection time was reduced and replaced by video dissections course marks did not change significantly. However, students scored cadaveric dissection higher than video dissection for learning and understanding gross anatomy.

PT: Physical therapy/physiotherapy, USA: United States of America, VARK model: Visual, Auditory, Read/write, Kinesthetic model

Table 3.5: Charting table for Categories 4 and 5: Studies of Team-Based Learning (TBL), Peer Teaching, Mentoring and Tutoring in Gross Anatomy for Undergraduate Physiotherapy Students

Studies (n=7)	Study designs	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Huitt et al. 2015 [27]	Cross-sectional, observational	USA	To investigate the use of TBL as a substitute for 1/3rd of gross anatomy cadaver dissections. To determine the outcomes of TBL on academic performance in PT student body. To determine how students rank teamwork roles. To determine the impact of the TBL intervention on the retention of content at measured intervals.	An experimental group was divided into three subgroups (4 students with equal gender distribution). Groups were rotated between TBL and dissection. Four phases to TBL process: 1) objectives related to dissection activities for day sent to students approx. 1 week prior to TBL session 2) iRAT and GRAT tests were administered to students. Any problems resolved through discussion 3) Teams discussed and analyzed clinical cases in open book forum and answered MCQs. Each team presented conclusions and discussion was held until consensus emerged. Peer teaching with dissection group teaching TBL group about the dissection and the TBL group linking the dissection to clinical case scenarios.	Significant positive correlations were seen between the comparison, pre-survey and post-survey groups for certain statements: “I have a positive attitude about working with my peers”, “The ability to collaborate with my peers is necessary if I am to be a successful student’ “ TBL will help me prepare for course examinations”. Significant correlation was found between the comparison group and post survey group for: “TBL will help me increase my understanding of the course materials’” Solving problems in a group is an effective way to practice what I have learnt” and “ working well with my peers will make me a better physiotherapist”. Academically the experimental group had a sustained trend towards improved performance and there was an increase in higher grades recorded. There was a significant ($P< 0.001$) improvement in the head and neck region of the final written examination. Anatomical retention in the experimental group after one year was significantly improved ($P< 0.007$) compared to a comparison group that had taken anatomy three years previously. Researchers noted that the passage of time and not the TBL intervention might have caused the difference. The use of the iRAT and GRAT assessments was believed to encourage students to develop sound and reliable study practices and prevent them lapsing in their studies. Survey responses validated the hypothesis that TBL results in deeper learning of anatomy and better examination preparation.
Livingston et al. 2014 [28]	Cross-sectional, observational	USA	To assess how PT students perceive TBL using Team-based learning self Assessment Inventory (TBL-SAI).	Students prepared by reading course information. Objectives were discussed in lecture. Each student filled in RAT. Teams filled in the tRAT. Student peer teaching and case discussions focused on specific joints. Written exercise was done on solving clinical scenarios.	Three chronologically sequential PT groups taking gross anatomy were tested after all groups had learnt anatomy with TBL. Gross anatomy grades across cohorts were above average. The (TBL-SAI) showed all three groups happy with the use of TBL. The time elapsing for each group to be retested might have influenced results.

Studies (n=7)	Study designs	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
de Oliveira et al. 2015 [43]	Descriptive, observational	Brazil	To discuss the strategies and activities of a peer-mentoring programme to ascertain if this will facilitate and improve anatomy teaching as applied in IPE.	Mentoring sessions coincided with anatomy lectures on topic. Mentors demonstrated anatomical structures using prosected cadavers and staff produced instruction manuals. Mentors applied clinical and professional information during demonstration. They developed mock practical tests. Email was used for mentors to communicate with lecturers and support mentees. Problems were solved during bi-monthly meetings between mentors and advisors.	In most instances peer mentors showed mastery of anatomy content, were organized in their presentation of the work and assisted the students efficiently. Mentees found the mentoring helped them with their examination results and most (97%) wanted the mentoring experience to continue. Peer mentors regarded the mentoring experience as rewarding, enjoyed the teamwork aspect and the development of organizational skills. Interaction with lecturers developed important skills for future professional practice and enhancement of knowledge. Contrarily, mentoring required much dedication, produced many challenges with regard to mastering the material sufficiently and mentors needed to learn to teach and overcome any feelings of shyness or inadequacy.
Wait et al. 2009 [40]	Cross-sectional, descriptive	USA	To evaluate perceptions of PT students regarding an Audience Response System (ARS) intervention. To record PT peer teacher opinion's on using ARS in interactive sessions.	Peer-teaching class anatomy quiz of 12-15 questions were entered into ARS as MCQs. Students answered by means of 'clickers (ARS key pad). Peer teachers helped answer questions during the session. Student groups were given a packet containing various questions, textbook information and helpful study hints. They discussed questions within groups. Peer teachers followed up with students who had difficulty. Surveys were distributed to both teachers and students to assess the ARS and the peer teaching.	The use of 'clickers' in ARS built student confidence for participation in anatomy discussion groups and helped students gauge their understanding of a topic. Students liked the immediacy of ARS for quick assessment of how well they learnt and understood anatomy. Peer teacher's anatomy improved with the writing of 'clicker' questions. Contrarily, it was described as an impersonal and passive type of teaching with not enough interaction. Peer teachers noted that it was difficult to formulate questions about specific concepts requiring long answers using the ARS format.
Youdas et al. 2008 [41]	Cross-sectional, descriptive	USA	To evaluate PT students' perceptions of gross anatomy peer teaching. To report peer teachers perceptions regarding: peer teaching, academic benefits and organization of such a programme.	PRS took place in the DPT anatomy programme. Peer tutors gave students a packet with useful hints, textbook and course note information on region to be covered. Students were encouraged to discuss anatomical topics. Peer teachers answered unsolved questions. They sometimes took students to cadaveric prosections to clarify structures. Review session three had a mock spot test format.	A majority (78.6%) of students felt PRS helped with weekly anatomy quizzes, 64% felt they improved practical examination scores, and 85.7% improved in written examinations. The learning of key anatomy structures was aided by PRS according to 89% of students. Negatively students (75%) did not think that the tutors covered functional movement patterns well. Helpful elements of PRS: " I really liked the worksheets and how the teachers were available to answer questions" and "I liked the ability to ask questions and

Studies (n=7)	Study designs	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
					have them explained in a new way." Suggested improvements: " Have first year students email specific questions to peer teachers prior to each teaching session so hand outs focused on specific student needs". Peer tutors felt the experience helped confidence, improved teaching skills and helped them apply anatomy in the musculoskeletal PT classwork.
Youdas et al. 2007 [42]	Cross-sectional, descriptive	USA	To evaluate the use of reciprocal peer teaching (RPT) in gross anatomy. To assess the impact that RPT has on gross anatomy examination results.	As an adjunct to an hour-long lecture and dissection practical the intervention group divided into groups of four. Each group had to present an anatomy demonstration twice on a rotational basis. A control group did the same anatomy without the RPT.	A RPT intervention: increased students' teaching skills (86%) and teaching confidence (96%), enhanced learning of gross anatomy topics (96%), gave more confidence with exams (70%) and better understanding and retention of anatomy (100%). Qualitatively the research revealed that: "Hearing other students' perspectives and what helped them remember the information made it easier to learn." To improve the RPT process it was suggested sessions should not be held on the same day as dissection as the workload was a lot.
Lake, 1999 [44]	Cross – sectional, descriptive	USA	To measure the effectiveness of a peer tutoring intervention	Control group had conventional anatomy. Intervention group had peer-tutoring sessions. Tutors revised the core syllabus and engaged the students individually or in groups.	Physiotherapy students undergoing peer tutoring showed less decline between anatomy introductory course grades and grades in the more complex gross anatomy course than students who did not have peer tutoring. Increased number of times students attended peer tutoring influenced the results positively. Students found the tutoring a valuable experience and wanted tutoring to continue in future courses.

ARS: Audience response system, GRAT: Group Readiness Assurance Test, iRAT: Individual Readiness Assurance Test, MCQ: Multiple choice question, PRS: Peer review sessions, PT: Physical therapy/physiotherapy, RAT Readiness Assurance Test, RPT: Reciprocal peer teaching, TBL: Team-based learning, TBL-SAI: Team-based Learning Student Assessment Inventory, USA: United States of America

Table 3.6: Charting Table for Category 6: Studies Pertaining to Curriculum, Pedagogy and Materials used in Gross Anatomy for Undergraduate Physiotherapy (PT) Students

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Shead et al. 2018 [53]	Cross-sectional, descriptive	South Africa	To document factors relating to gross anatomy education for undergraduate PT students.	The survey was purpose built using guidelines from a previous survey undertaken in the USA. Aspects of the 42-question survey were tested for internal reliability and validity. It was also peer reviewed. Questions were of the MCQ type but in places respondents could add more descriptive answers to explain their choices. The survey was sent to nine possible PT gross anatomy course coordinators at eight faculties. Reminders were sent. Survey lasted six weeks.	Out of nine possible respondents seven (77.8%) responded from six of the eight faculties (75%). Two participants were from the same faculty so their results were pooled. Average number of staff per faculty 7.8 (± 4.7). Average years of staff experience 8.6 (± 3.3). Ratio of male to female staff: 1:2. Staff qualifications differed throughout faculties. Average number of PT students per faculty 60.5 (± 12.6). Staff to student ratio = under 1:10, (1:3, 1:5, 1:8) to over 1:30 (1:30, 1:35, 1:39). Total hours spent in anatomy course; 207.6 (±78) distributed as 100,182,196,252 and 308 hours across five faculties. Mean number of cadavers was 6.43 (± 7.30). Students per cadaver averaged 8.0 (± 3.5) and ranged from 4-6 students to 10-12 students. Teaching pedagogies: 83.3% of the faculties used dissection and/or prosection and plastinated specimens/anatomical models. Direct contact hours per week for dissection averaged 3.3 (± 2.0) hours. Time per programme per week for prosection observation: 0.9 (± 0.7) hours. Time spent in lectures per week: 4.3 (±1.7) hours. Half of surveyed faculties did not use computers. Surface/ living anatomy was practiced in the majority of faculties using cadavers, student volunteers or student self-palpation. Sometimes cultural or religious restrictions influenced the use of this pedagogy. Approaches to learning and assessment: regional (50.0%), systemic (16.7%) and mixed methods (33.4%). All programmes used MCQs, short essay questions and timed spot tests for assessment. One also included a long essay question at each examination. Three had viva voce examinations. Student evaluated staff in most faculties and four faculties were revising their gross anatomy programs with a view to changes.
Reimer et al. 2013 [13]	Cross-sectional descriptive	USA	To gain information about PT schools which teach gross anatomy in their respective programs.	In 2013 a 42-question survey document was distributed to possible participants at 204 Commission of Accreditation in Physical Therapy Education (CAPTE) approved PT schools. Survey questions were MCQs and were divided into 6 categories.	The researchers compared some 2013 findings with those recorded in a similar 1994 survey. There were 103 respondents (71%) in 1994 and 69 respondents (34%) in 2013. Institution Public Private Semi-private 2013 survey 56% 43.5% 0% 1994 survey 44% 43.7% 16%

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
				Participants had three weeks to complete the survey.	With regard to staff qualification: PT qualified in 2013: 29.59% of programs, PT qualified in 1994: 50% of programmes. Other students sharing the laboratory with PT students: in 2013 programmes (76.8%) shared the laboratory, in 1994 (36.2%) shared. Teaching pedagogies in 2013: Dissection (92.6%), Prosection (31.9%), Plastinated specimens (50.7%) and CAL (50.7%). In 1994: Dissection (100%) and CAL (18.4%).
Mattingly and Barnes 1994[14]	Cross-sectional descriptive	USA	To determine how PT programs in the USA teach human anatomy.	In 1994 a 92-item MCQ questionnaire contained five sections. 1. Demographics Other sections were: content of the anatomy course, current anatomy course costs, projected costs and the textbooks. The survey document was mailed to 145 primary anatomy instructors. A follow-up reminder was sent. Participants were asked to rate specific areas for possible inclusion in a gross anatomy course. Open-ended questions gathered qualitative data.	In the 1994 survey the researchers suggested that a gross anatomy course for PT students should be exclusive to PT students. It also concluded that cadaver –based teaching is still the most popular form of gross anatomy instruction. The 1994 survey concluded that important content was the upper limb and in particular the brachial plexus (98.9%), spinal cord (94.7%), lower limb, thorax and brain (69.2%). Least important content related to the abdomen and aspects of the pelvis. The 2013 survey also found: Staff experience: ranged from > 20years (27.54%), 11-20 years (26.09%), 6-10 years (18.84%, 1-5 years (24.64%) to < 1 year (2.9%) Student numbers per class: < 30 students (20.59%), 31-50(57.35%), 51-70 (16.18%) and 71-90 (5.89%) Time spent in laboratory by students: 3-4 hours (32.35%), 5-6 hours (41.4%) and > 6 hours (32.35%) Average number of cadavers available: 8.72. Students to cadaver: 1-3 (n= 4, 6.25%), 4-6 (n= 61,87.5%), 7-9 (n=3, 4.69%) 10-12 (n=1,1.56%). Plastinated models available in programs: two models (n=4, (16%), 3-6 models (n=10, 40%), > 10 models (n=9, 36%) and > 20 models (n=2, 8%).
Khan et al. 2015 [54]	Cross-sectional descriptive	Pakistan	To recognize and identify the importance of anatomy as a subject for physiotherapists and undergraduate PT students and establish whether PT students feel it appropriate for their degree.	Survey was specifically designed and had six questions. It was rated as A (agree), B (disagree), C (do not know). Distributed to physiotherapists registered with the Pakistan Physical Therapy Association and undergraduate PT university students (N=1100) (sample size: 500) between January and October 2011.	Survey response: 286 (57.2%) were collected. The survey found that: significantly (P<0.001) undergraduate students (53.2%) were either unsure or did not think that gross anatomy should only be studied as clinical anatomy but qualified physiotherapists (72.8%) were in favor of this. Both the student (75.6%) and qualified practitioner (60.5%) populations felt that dissection is helpful in understanding and retaining anatomy (P<0.001). The students (65.4%) and the physiotherapists (77.8%) strongly felt that anatomy was not memorized by multiple readings (P<0.041). The vast majority of PT students (88.8%) and qualified physiotherapists (95.1%) believed videos to be essential component to an anatomy course. 97.9% of participants found anatomy to be important in PT.

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Melguizo et al. 2007 [97]	Cross-sectional descriptive	Spain	To establish what PT students feel about practical and theoretical anatomy pedagogy, the musculoskeletal part of the anatomy course, tutorial assistance and the way in which they were examined.	Anatomy teachers from three different universities conducted this study. The sample of 117 first year PT students, from two Spanish universities, participated in the part of the anatomy course designated as structure and function of the human body. This section of their anatomy course included the anatomy of the muscular and skeletal systems. After the conclusion of this part of their course they were invited to take part in a survey designed to assess certain aspects of their learning experience.	The survey was scored according to a five- part Likert-type scale. In block one the PT students at two universities felt that the inclusion of anatomy was highly appropriate to their degree course (Mean scores: Almería: 4.9; Jaén: 4.1). Objectives proposed for each thematic unit had the approval of 85% of the Almería University PT students (mean score: 4.1) and 65% of the Jaén University PT students (mean score: 3.8). The balance between theoretical and practical work was found to be appropriate (Almería mean score: 3.7, Jaén mean score: 3.5) and the traditional anatomy teaching methods were viewed positively and given a mean score of 4.2 by 80% of Almería PT students and a mean score of 3.5 by 50% of Jaén PT students. In block two, multimedia- teaching methods were more popular and were rated higher than the more traditional methods of teaching (e.g. blackboard). Almeria PT students (75%) enjoyed the use of slides most while Jaén students preferred multimedia presentations (mean score: 4.2). Both groups of students rated the use of anatomical models as the most highly valued practical resource (Almeria mean score: 4.3, Jaén mean score: 4.0). Block three items resulted in the PT students choosing written examinations/tests (80% of Almeria PT students: 4.3, 60% of Jaén PT students: 3.9) for theoretical evaluation. Most popular method for practical evaluation of the course was by means of anatomical schemes (Almeria mean score: 4.5, Jaén mean score: 4.2).
Gabard et al. 2012 [7]	Cross-sectional, descriptive	USA	To investigate teaching practices as they pertain to medical and PT schools during the survey period. To investigate and rank such factors with respect to anatomy pedagogy. To investigate how such instruction may vary by 2020.	A study instrument was drawn up after an extensive literature review. It consisted of three parts. In line with the Delphi survey design the instrument underwent repeat appraisal. This was done using the identified sample population until consensus was reached. Two rounds were used General Survey Instrument- two sections Section 1: Had 10 instructional technique categories with a column for present pedagogies, one for suggestions for future	The populations for the research of PT anatomy programs were: PT general anatomy instructors (GPTAI) and PT expert anatomy instructors (EPTAI) identified from the DPT programs with accreditation from CAPTE)(2009)(N=194). After eliminating those participants involved in the Delphi study and the two academic institutions conducting the research the resultant sample size was n=143. 1.Results for average percentage time spent on total body cadaver dissections by students: Current survey time: GPTAI (60.31%)(range 0-100%) and EPTAI (67.86%)(range 0-100%). Future time-2020: GPTAI (47.70%)(range 0-100%) and EPTAI (64.0%)(range 10-100%). 2.Results for the average percentage of instructional time spent on living/surface anatomy: Current survey time: GPTAI (6.50%)(range 0-30%) and EPTAI (8.64%)(range 0-33%). Future time-2020: GPTAI

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
				pedagogies (2020) and a third for comments. Section 2: was divided into three columns. The first two dealt with main factors influencing teaching pedagogies and the third was for comments. The survey was sent on 26 October 2009. After four reminders the intervention ended on February 23 2010.	(7.08%)(range 0-65%) and EPTAI (18.60%)(range 0-20%) 3.The results for the average percentage of instructional time spent on Imaging: Current survey time: GPTAI (3.42%)(range 0-30%) and EPTAI (3.5.7%)(range 0-20%). Future time-2020: GPTAI (6.07%)(range 0-30%) and EPTAI (9.80%)(range 0-30%). Amount of available time, instructor availability and budget constraints would have a significant effect on anatomy instruction at the present time and in the future (2020). The relationship between student learning styles and the methods used to teach them was highlighted in the current situation by the GPTAI group. The group felt that its importance would decrease in the future. Responses to changes in curricula: The EPTAI group did not believe that this was an important consideration either for current teaching or future teaching.
Latman and Lanier 2001 [17]	Cross-sectional, descriptive	USA	To get a sample of anatomy experiences and a viewpoint on what allied health clinical professionals recommend with regard to a gross anatomy course.	Targeted clinical populations were identified using licensing board lists for the state of Texas (USA). Randomly selected clinical populations were sent the survey. It consisted of a five-question demographic questionnaire and a 14-question section for clinicians' experiences and recommendations for gross anatomy.	Physiotherapists (76%) felt that an anatomy course would be best in the first semester. They mentioned the beneficial outcome of having early exposure to gross anatomy as better preparation for the subsequent courses that relied on a basic anatomical knowledge. It was suggested that an ancillary course relating gross anatomy to clinical situations might also be beneficial in this regard. A person with a PT qualification had taught gross anatomy to 49% of the respondents. As far as IPE was concerned 55% of the PT respondents felt it to be a good idea. PT clinicians favored the inclusion of the nervous and muscular systems in course content and rated inclusion of the lower limb and back equally (17%) slightly more than the upper limb (16%).
Armstrong and Rosser 1996 [91]	Cross-sectional, descriptive	Canada	To compare the way in which human gross anatomy is taught in Canada and in the USA in order to endeavor to improve these courses in both countries.	The survey instrument design was based on an unrelated survey that had been developed to enquire about gross anatomy teaching of dental students. The survey was sent to the relevant institutions in Canada and the USA in May 1994.	Responses from the Canadian institutions: 12 (92.3%) and US institutions: 33 (66%). Canadian institutions' enrolment: 30 - 80 PT students (mean 52.0 ± 6.0). The USA institutions' enrolment: 20-150 PT students (mean 49.0 ± 4.0). Responses to a survey showed that 91% (Canadian) and 42% (USA) of the sample reported that PT students had integrated gross anatomy classes with non-PT students. In Canada the PT students were mixed with OT students in 100% of the courses. In the USA 62% of gross anatomy programs did this. The number of hours overall allocated to gross anatomy programs ranged from 74 -233 hours in Canada (mean 144 ± 14) and

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
					in the USA 70 - 247 hours (mean 149 ± 7). The mean number of hours in lectures were: Canada: 62 (± 4) hours and US: 47 (± 3) hours. The mean number of hours spent in practical's was: Canada: 69 (±12) hours and USA: 89 (± 5) hours. In Canada 58% and in the USA 9% of institutions offered prosection for PT students. In Canada 25% of institutions offered a mixed prosection and dissection program. In America 53% of PT students dissected and 38% offered a mixed programme. American institutions favored a regional approach (97%). In Canada only 36% did this and 18% of the Canadian institutions used a purely systematic approach. Canadian and American courses mirrored each other in content to a large extent. However, in the USA there was more emphasis on the back and in Canada more emphasis on the abdomen. Physical therapy students in Canada and the USA spend 46% and 48% respectively of their gross anatomy course studying the upper and lower limbs. Textbooks were required by 82% of Canadian institutions but this was a requirement at all (100%) of the USA institutions. Anatomical atlases were required in 81% of US institutions and 100% of Canadian institutions. Data obtained from the questionnaire showed that 78% of the gross anatomy courses in USA and 73% in Canada had at least one instructor or TA who held a PT degree.
McKenzie and Gutierrez 2007 [92]	Cross-sectional, observation	USA	To document the content of the Varied-integrative-Progressive (VIP) model of anatomy instruction, evaluate students' perceptions regarding VIP, evaluate learning outcomes from VIP and estimate the costs of running the VIP model.	The VIP model was designed to incorporate anatomy content for DPT students across the entire curriculum. First year DPT students were given evidence-based lectures, discussions that included clinical examples and PBL. They had access to computer –based technology, videos, objective manuals, tutors and other learning aids. Quizzes and other interactive activities within the course encouraged on going learning assessment. Students did surface anatomy and applied anatomy at the "dry lab	In questions pertaining to the use of prosections the first year DPT students showed an overall positive response (70-90%) and "a lot" response to the helpful role of cadaveric prosections in relationship to: a) The relearning and retention of anatomy information b) Understanding 3D relationships c) Discerning normal variation in cadaveric material d) Appreciating age-related and pathological changes e) Appreciating the differences between tissues f) Learning about respect for human life. Most popular study methods used by the first year DPT students included: Review and reading of course notes (94.7%); use of an anatomy atlas book (60.5%); utilizing flashcards (55.3%); re-examining "dry lab" specimens (50.0%) and revising using cadavers (44.7%). Second year DPT students showed a positive response and recorded a high perception of satisfaction with the role dissection played in their learning (70-85%). All of the class agreed that this form of pedagogy was important to their study of PT (100%). The three most

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
				stations", worked with cadaveric prosections at the "wet lab stations". Staff promoted discussion, demonstrated and affirmed or clarified students' output. Second year DPT students' had lectures, dissection, discussions, peer teaching and student self-motivated learning. They were also required to undertake a "capstone project" where literature was reviewed, a relevant article was discussed with classmates and a detailed pertinent dissection was demonstrated.	popular study methods for second year DPT students were: To review and read first year anatomy course notes (54.2%); to review or read the anatomy textbook (37.5%) and to use study groups (29.2%). The most popular dissection resource used by DPT students was the dissection manual (50.0%). "Capstone projects:" 79% of respondents felt that working on their own project had helped them "a lot" with anatomy. Among the favorite aspects of the projects three main themes were identified. 1. The process of completing the project and having the chance to listen to presentations by the other students presented learning opportunities. 2. The chance to chose a topic of interest and then work on it in an independent fashion. 3. Work produced from peer projects and their own project could be collected and used for future professional reference purposes. Among the least favorite aspects were: 1.Writing papers on their topic. 2. Performing presentations for their peers.3.The amount of preparation involved for the project.
Traser et al. 2015 [55]	Cross-sectional, descriptive, research report	USA	To ascertain students' perceptions regarding usefulness of quick response (QR) codes in gross anatomy. To assess how examination grades are influenced by the use of QR codes. To evaluate whether frequency of use of the tool impacts student performance.	The gross anatomy course had three units. Each unit covered different regions of the body and had lectures, cadaver dissections, radiological imaging and clinical content sessions. Six students were assigned to each cadaver. Three acted as peer mentors while the other three dissected and this process was alternated. During the first unit no mention was made of QR codes. It was used as an internal control. A prosected cadaver was tagged and named the "QR code cadaver". During the period of the intervention each week 10-15 structures were selected and tagged by anatomy researcher. Selection of tagged structures	Students said: "The QR codes provided a quick and interactive way to check knowledge which is helpful for staying on top of the content of the course. It was nice to be able to quiz myself and receive immediate and informative feedback", 2) "Repeated and expanded exposure to content", 3)"The QR codes were like a mini practical. They were also helpful in providing insight into how test questions may be posed on the actual practical", 4) "Study guidance": " They provided extra practice that was convenient and accessible to everyone. They helped gauge where you are with the laboratory material which allows you to change or maintain your current study habits" and 5) "Quality of resource": " Quick and easy way to test myself even if I didn't have a study partner or instructor around". With regard to the "dislike" aspect two themes were identified: 1)" Impediments": a) Movement of the tags by others resulting in difficulty with untangling the tags in order to identify the structure. b) Difficulty encountered by a student with no smart phone that meant that the student did not participate in the in laboratory quizzes. c) When the answer was long the student would be referred to a web page for the detailed answer. Weak signal in laboratory so online connection could not be established.

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
				was linked to those dissected or taught in a lecture. The QR code tags on the prosected cadaver were changed weekly. The QR codes were scanned using a smartphone or other mobile device to get the answers. A hard copy of answers was available for students who had forgotten their device or had no device.	2) "Reluctance to use personal mobile device in the gross anatomy laboratory": One of the concerns related to the fear of the phone being exposed to unsanitary conditions. Another related to a matter of privacy. Suggested solutions to these problems included the use of enhanced embedded responses, better tagging methods so as to avoid the issue of tangling up of the tags and the use of traditional cards with the answer printed on the reverse side in order to avoid the use of private technological devices. With regard to the third open –ended question asking for further comments on the use of QR codes in the gross anatomy laboratory' two of the issues raised were: a) To label the pin on the structure with a number and taping the corresponding QR code onto the side of the table. b) Questions that require the student to identify a structure need more explanation e g an explanation on how to identify it perhaps by the use of surrounding structures.
Nanjundaiah and Chowdapurkar 2012 [96]	Cross-sectional, descriptive	India	To encourage peer learning and students to actively participate in the learning process. To help students identify surface body marks easily. To make the surface anatomy experience more relevant to future clinical practice	Body painting was done using colored non- toxic paints. Students did a skin test patch with paint the day before to avoid allergic reactions. They first learnt surface anatomy of the lower limb using a traditional method of palpating landmarks on a cadaver. Surface anatomy for the upper limb was conducted using the body-painting technique. Students had 20 minutes to paint anatomical structures on their peer partners and then a further 20 minutes to paint the structures on themselves.	The questionnaire results were for the entire student population of both PT students and Dental students. 1.The majority of students (98.7%) found the task interesting. 2. 98.7% of the students participated actively. 3. After the intervention 96.1% found that they could list the structures learnt easily. 4. Peer learning was given approval by 96.1% of the students. 5.The majority of students (90.9%) felt that the exercise supplied them with the feel of the painted landmarks and structures. 6.Body painting was seen to provide a better learning experience, with regard to the retention of learned material, by a high percentage of students (98.7%). The comparison of the relevant student responses relating to the body-painting experience and the traditional experience for the learning of landmarks and other structures found insignificant evidence to suggest either method was superior to the other.
Gangata 2008 [95]	Cross-sectional descriptive	South Africa	To investigate whether health science students who use tactile, 'hands on' techniques to learn spatial anatomy will	In the "muscle cut out exercise" (MCOE) 2D diagrams of certain muscles of the upper and lower limbs were made. The muscle diagrams fitted the size from origin to insertion of muscles on	A survey consisting of 29 MCQs and four descriptive questions was administered at the end of the semester. Fifty-six students (46.6%) out of N=120 students completed it. Of the participants 30 were PT students and 26 were OT students. Eleven were female and 45 were male. Results for the MCQs were collated to produce a "Final weighted

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
			exhibit better learning outcomes.	two specific skeletons. Written detail of origin, insertion, muscle function and innervation were entered on the diagrams. Information was made into a 22 A4 page document "Long muscles" were produced on a single A2 sheet. Students had hard copies of the document and utilized it to cut out and paste the correct muscle onto the skeleton. The exercise lasted 15 minutes.	aggregate score" and "overall comments". In general students (92%) found the MCOE a very useful and innovative way of learning the topic. When asked about the paper cut out flaws students pointed out that some MCOE were not sized correctly for the skeleton being used and Prestik was in short a supply. In response to how to improve the exercise students offered that coloring the "muscles" would improve the impact and skeleton size should match the cut out. When questioned about disadvantages of dissection students commented that groups were very large and there was a problem with adequate staff assistance. Positively they did mention that they did know what they were "cutting up". The section on short comments resulted in statements such as: "MCOE was helpful in learning the spatial relationships of the muscles". The students found the experience fun and enjoyable and the researcher noted that the exercise was low-cost, a practical application and easily reproducible at home or anywhere in the world.
Prados et al. 2007 [93]	Cross-sectional, observation	Spain	To analyze specific factors affecting the learning of anatomy and the application of a new anatomy teaching methodology for health science students.	The anatomy and clinical relevance of the cardiovascular system was explained to all students using clinical videos, dissection, anatomical models and diagnostic images They were placed in groups and also encouraged to work individually to enhance understanding of anatomy, improve the learning ethic and self-test. Post-intervention they were asked to complete a survey to give feedback on their opinion of the anatomy course.	Measurement of the outcomes was done by means of a survey scored using a five-point Likert scale. The higher the score the more positive the result. The PT students rated the relationship between anatomy and their future clinical career above average (3.4). All student populations rated the clinical application of their attained anatomical knowledge the same (4.2). With regard to how satisfied students were with the anatomical knowledge they received, how well the teachers facilitated motivation for learning, the clinical application of anatomy and general satisfaction with the anatomy course there was no significant difference between the group scores. PT students (3.5) were less satisfied with their anatomy learning than the other groups but results were positive. With regards to the new methodology used to teach the cardiovascular system, all groups felt positively about the appropriateness of this pedagogy for the learning of this topic (PT mean score= 3.9). Students liked the new teaching method and felt that it should be used to teach 70-100% of the subject.
Bukowski et al. 1980 [94]	Cross-sectional, descriptive	USA	To compare a traditional textbook method and a self-	A pre-test using a 40-item MCQ format was administered to the participants prior to the	A textbook versus self-instruction study: Due to a 30% attrition rate the final participants were 35 volunteer qualified physical therapists and 14 volunteer PT students (total n=49). The therapist textbook (T)

Studies (n=14)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
			instructional method of anatomical learning about the hip and knee.	intervention. For the main study the participants were divided into two groups each consisting of qualified physical therapists and UG PT students. One group used textbooks and the other used the self-instruction format. Both groups were given the same learning objectives. Groups were set a specific time to complete their task and were not given access to the other means of learning. Participants were re-tested using the 40-item MCQ format. An attitudinal questionnaire was also administered post intervention. This test was again given to the participants after six months to assess the possible change in the retention rate since the post-test and to compare the value of both learning methodologies in this regard.	group = 22, the therapist self- instruction (SI) group = 13. The student T group = 6, the student SI group= 8 The pre-test scores were: Therapists (T) 27.2 ± 4.8 and (SI) 28.2 ± 4.5 Students (T) 28.0 ± 3.2 and (SI 30.3 ± 2.4 The post-test scores were: Therapists (T) 30.5 ± 4.6 and (SI) 30.4 ± 4.4 Students (T) 32.0 ± 1.6 and (SI) 34.7 ± 1.9 The 6-month follow up scores were: Therapists (T) 27.9 ± 5.2 and (SI) 29.6 ±3.7 Students (T) 31.7 ± 1.9 and (SI) 31.6 ± 2.8 With regards to the paired t –test comparison of pre- and post-test scores significant (P=0.01) changes in the learning performance were noted for the therapists group (n=22 who used textbook learning and also significant (P=0.05) changes in knowledge retention were noted for the mixed group that used textbook learning. The unpaired t-test comparing scores for therapists in the SI category with those for students in the SI category showed a significant (P= 0.05) difference. Less average study time was spent on the SI format than on the textbook method. Decreased time for students = 2 hours 17 minutes. Decreased time for therapists – 1 hour 6 minutes. The pre-test score was significant (P=0.01) in the SI group for indicating their retention rate. The attitudinal questionnaire indicated that participants were open to the idea of new forms of anatomical learning to be investigated and instigated.

CAL: Computer-assisted learning, CAPTE: Commission of Accreditation in Physical Therapy Education, 2D: Two-dimensional, 3D: Three-dimensional, DPT: Doctor of physical therapy, EPTAI: Expert physical therapy anatomy instructors, GPTAI: General physical therapy anatomy instructors, IPE: Inter-professional education, MCOE: “Muscle cut out exercise”, MCQs: Multiple choice questions, OT: Occupational therapy, PT: Physical therapy, QR codes: Quick response codes, SI: Self-instruction, T: Textbook, TA: Teaching assistant, USA: United States of Ame

Table 3.7: Charting Table for Category 7: Studies Pertaining to Clinical Input into Gross Anatomy Curriculum, Case-Based Teaching and Vertical Integration used in Gross Anatomy for Undergraduate Physiotherapy (PT) Students

<table>
<tr><th>Studies (n=4)</th><th>Study design</th><th>Location</th><th>Aims/purpose of included studies</th><th>Methodologies of included studies</th><th>Key findings across studies</th></tr>
<tr><td>Janssen et al. 2014 [21]</td><td>Randomized controlled trial followed by cross-sectional, descriptive design</td><td>USA</td><td>To assess the competency of first year students in the performance of the Lachman test on lightly embalmed cadavers. To compare the post-test scores for each group.
To examine self-assessed confidence of students who perform the Lachman test.</td><td>Pre- intervention students from the medical, physicians assistant (PA) or PT groups were randomly assigned to Group A (n=111) or Group B (n=114). Students in both groups were given the course lecture on the knee joint, instruction on how to perform the Lachman test, a demonstration of the knee joint and its associated ligaments, menisci and muscles using cadaveric material and a list of contraindications to the test. A 15-minute training session involving a lecture and hands-on training using a lightly embalmed cadaver was given to Group A. Then students participated in a hands-on training session where they practiced the Lachman test on cadavers to experience both an intact anterior cruciate ligament (ACL) and a ruptured ACL. Students had to determine and state whether the ACL was intact or ruptured and give feedback on their findings. Once the diagnosis was revealed students were able to re-test the ligaments in order to better establish the ‘feel’ of both types of ligaments (intact or ruptured).</td><td>The competency of the students to perform the Lachman test in group A was assessed after the lecture, surface anatomy classes and the hands-on intervention while the competency of the students in group B to do the test was assessed after the lecture and surface anatomy classes only. Scoring was done using 0 = not done/ done correctly and 1= done correctly. Assessment for the PT students took place after eight days. Seven of the students in group A and 11 of the group B students reported that they had learnt how to perform the Lachman test previously.
Group A: 38 students were PT students. Group B: 43 students were PT students.
1) Group A participants scored significantly higher (P< 0.0001)(median of 9 out of 9 steps) than those in Group B (5 steps correct) with regard to the correct way in which they performed the Lachman test. 2) Group A students showed better accuracy in identifying a torn ACL than group B students.
The table shows the statistics for correct diagnosis of a ruptured ACL.
<table>
<tr><th>Student body</th><th>Group A N (%)correct</th><th>Group B N (%) correct</th><th>P –value</th></tr>
<tr><td>PA/PT 2010-2011</td><td>19/24 (79%)</td><td>7/23 (30%)</td><td>0.001</td></tr>
<tr><td>PA/PT 2011-2012</td><td>24/44 (55%)</td><td>12/46(26%)</td><td>0.01</td></tr>
</table></td></tr>
<tr><td>Krause et al. 2011 [22]</td><td>A pilot cross-sectional study</td><td>USA</td><td>To allow students to have the opportunity to revise aspects of gross anatomy later in the DPT course.</td><td>Before the students took part in the intervention they were given information booklets that described the regional anatomy of the joints to be tested, the anatomy of the associated structures</td><td>Post-intervention students completed a seven-question survey and answered three open-ended questions. 22 of 26 students (85%) participated.
1. 91% (n=20) of students reported that the clinical testing experience helped them understand anatomy better. 2. 95% (n=21) of students had a positive response to IPE. 3. All</td></tr>
</table>

Studies (n=4)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
			To obtain maximal " educational value" from students' time spent in a gross anatomy laboratory.	required to be identified and cut and the tests to be performed on the joints. Students revised the anatomy pertaining to the tests that they would perform on each joint and also practiced and demonstrated the tests in a clinical skills session. Two students were assigned per cadaver. The joints and associated ligaments tested were: knee, ankle, shoulder, elbow and hand/thumb.	students felt this type of anatomy education should be included in the course 4. Students agreed that they were more motivated to learn anatomy post- intervention. 5. 95% (n=21) of them felt very strongly that the experience enhanced interest in anatomy. 6. 86% (n=19) of students liked the intervention and found it a useful way to learn anatomy. 7. Boosting of confidence in understanding and reporting results of clinical tests was reported (n=16,73%) students.
Parmar and Rathinam 2011 [100]	Pilot cross-sectional study	India	To evaluate whether exposure to innovative anatomy pedagogies benefitted PT and OT students	A pre-test was administered to the student sample to ascertain their current level of anatomy knowledge in relation to respiratory anatomy. The intervention consisted of didactic lectures and demonstrations with prosected cadavers for certain areas of respiratory anatomy. The students in two mixed disciplines groups (n=10) were given a clinically relevant case at the end of the first session. The anatomy teaching staff taught the necessary anatomy by discussing it in relationship to the clinical relevance of its application to the case. After the second session a post-test that was designed very much along the lines of the pre-test was administered to the students. A further post-test was conducted four weeks post intervention. The effectiveness of the intervention was rated by the students, using an open ended standardized questionnaire, after each session.	In a study with PT and OT students where the results for both disciplines were reported together of the 20 students in the sample 18 completed the pre-test and 17 completed both of the post–tests. Quantitative data: Integrated didactic sessions: Paired t-test calculations were done. Mean pre-test score =10.50 (50.3%), Immediate post-test score = 15.88 (79.4%), 4 week post intervention score = 14.82 (74.1%). The post-test scores in both instances were found to be statistically significant ($p<0.001$). Students reported that the integrated anatomy learning format was beneficial and subject matter was relevant to clinical practice. CBL: Student report back for this aspect of the intervention could be divided into: Relevance of topics for CBL – 100.0%, Clinically applicable- 87.5%, CBL time not long enough- 68.8%. Both aspects of intervention: Improved learning of anatomy- 93.8%, Similar CBL and integrated programmem should be used in first year- 68.8%. Qualitative data: Open- ended question answer themes included 'CBL makes learning very interesting (100%)," "effective (60%)," and " very much appreciated.

Studies (n=4)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Prithishkumar and Holla 2012 [20]	Pilot RCT with descriptive cross-sectional qualitative component	India	To evaluate the effectiveness of an Early Clinical Exposure (ECE) programmeme offered to first year UG PT and OT students. To determine students' opinions on this type of intervention in neuro-anatomy learning as an alternative approach.	The neuro-anatomy of the brain and spinal cord was taught to 20/60 of the students using the ECE programme. The programme was divided into three sections: 1. Lectures using PowerPoint and blackboard presentations. 2. Use of relevant prosected neuro-anatomy specimens.3. Visits by the students to the hospital wards where they were taught at the patient's bedside in a ward classroom setting. The other 40 students, acting as the control group, followed the traditional teaching approach. They discussed clinical examples in regular lecture times instead of having ward visits. Four patients were presented: A quadriplegic patient with a C5/C6 spinal cord lesion, a paraplegic patient with a T10 spinal cord lesion, a patient who had suffered a middle cerebral artery stroke and a patient with bilateral cerebellar impairment. The intervention group took a history of the problem and degree of functional impairment, did an appropriate clinical examination to learn how to accurately localize the injury and how to explain the reason for the clinical picture of the injury based on anatomy findings. The neurological pathways were taught in ward classrooms.	The 20 students in the intervention group were asked to fill in a questionnaire at the end of the neuro-anatomy teaching period rating the effectiveness of the ECE program This questionnaire had 11 questions including 3 that were open-ended. A Likert scale where 1= very poor and 5 = excellent was used to rate the answers. In relation to the outcomes measured: A student remarked " Since we can see the condition for ourselves, it is useful to retain memory of the subject". In relation to the understanding of the subject The views expressed by the students affirmed the usefulness of this method of teaching for better understanding of the subject. They pointed to the fact that seeing the patients was more interesting and led to a clearer understanding of anatomy than either having to imagine the condition or reading about it in a book. The students' comments and suggestions for possible additions to the programme included: 1. More frequent visits to the wards 2. Case based learning that would assist them with learning more work. 3. Exposure to various conditions this way. 4. Using this type of learning for all the regions of the body. Overall the ECE group rated the ECE programme as good (75%) and excellent (25%).

ACL: Anterior cruciate ligament, CBL; case-based learning, ECE: Early clinical exposure, DIP: Distal inter-phalangeal joint, MCP: Metacarpo-phalangeal joint, PIP: Proximal inter-phalangeal joint, OT: Occupational therapy PT: Physical therapy, USA: United States of America

Table 3.8: Charting Table for Category 8: Studies Pertaining to Professional, Ethical and Psychological Aspects of Gross Anatomy for Undergraduate Physiotherapy (PT) Students

Studies (n=3)	Study design	Location	Aims/purpose of included studies	Methodologies of included studies	Key findings across studies
Youdas et al. 2013 [89]	Cross-sectional descriptive	USA	To determine whether assessments using individual formative feedback (self and peer), at the half way point and after completion of a semester course in gross anatomy led to an improvement in a collection of ten physiotherapy professional behaviours in the participating DPT students.	A 16-week gross anatomy course had one–hour lectures on three days per week. Dissection laboratory sessions were three hours long and took place twice a week. The 28 students were divided into seven groups for dissection. They completed six biweekly, anonymous self- meand peer electronic assessments containing questions relating to ten targeted professional behaviours important to physical therapists. At week 8 the intervention took place and involved one-on-one feedback between a lecturer and each student. The lecturer praised a student showing an understanding and bias towards good professional development and encouraged further progress in those who needed to improve. Average length of the intervention between the student and faculty was ten minutes.	Feedback on results obtained in the pre-intervention self and peer assessment given to students included scores from the self assessments on the ten professional behaviors (weeks 2,4,6) and average peer score (1-5) for each of the ten professional behaviors pre-intervention period; An average peer total professionalism score (TPS) over the three assessment sessions and the written descriptive input provided from all pre-intervention self and peer surveys was given to students. Post intervention data were formulated from three more self and peer professional assessments done at week 10,12 and 14. The 10 professional behaviours measured were; 1. Critical thinking (CT), Responsibility (R), Problem solving (PS), Interpersonal skills (IS), Communication (C), Commitment to learning (CL), Professionalism (P), Effective use of time and resources (ETR), Stress management (SM) and use of constructive feedback (CF). The mid-semester intervention resulted in significant improvement by students in relation to all 10 professional behaviours. Mean (± SD) for these results at the pre intervention and post intervention stages were: 1. CT -4.25 (±0.29) and 4.45 (±0.31) (P =0.002) 2. R- 4.53 (±0.34) and 4.70 (±0.26)(P=0.010) 3. PS- 4.16(±0.24) and 4.39(±0.31)(P=0.000) 4. IS- 4.33(±0.38) and 4.48(±0.33)(P=0001 5. C- 4.25(±0.33) and 4.47(±0.26)(P=0.001) 6. CL- 4.53(±0.32) and 4.74(±0.26)(P= 0.007 7. P- 4.34(±0.33) and 4.53(±0.28)(P= 0.000) 8. ETR- 4.37(±0.37) and 4.53±(0.27)(P= 0.015 9. SM- 4.06(±0.33) and 4.38(±4.38)(P=0.000) 10. CF- 4.20(±0.27) and 4.38(±0.30)(P=0.005) Average TPSs differed significantly throughout the six assessments with greatest improvement been seen at weeks 12 and 14. Final assessments (week 14) showed the greatest significant improvement with scores better than at any other biweekly point.

Canby and Bush 2010 [111]	Cross-sectional, descriptive	USA	To introduce an innovative tool to foster an awareness of the humanistic aspects of the PT profession. To facilitate reflective learning in DPT students. To evaluate whether exposure to cadavers in a laboratory setting influences PT students' attitudes towards such sessions.	A DPT gross anatomy programme incorporated a "Humanities in Gross Anatomy (HuGA) project". It was designed to give students a more humanistic insight into their interaction with cadavers. It was delivered at a lecture pre-course. Students articulated their experiences in gross anatomy, at the end of the program by writing a story, writing poetry, writing a song or using another narrative. In a group (<5) the project had to be a performance of singing, an artwork or a short video.	In the solo category: 28 students chose the narrative option, one produced a newspaper article and one made a chalk pastel artwork entitled: "A continuing gift". The artist explained her appreciation for the selfless generosity of the donor and used the artwork to express the significance of the gift of knowledge given by the mortal remains. Three students wrote poetry. One of the poems thanked the cadaver for the gift of knowledge and she promised to never forget this person who had taught her to work with integrity, respect and in a professional manner. In the group category: two groups made video productions. In one the students played the role of parents explaining to their offspring why they had chosen to donate their bodies for scientific research. Another group made a radio show and the fourth group produced a montage of text scraps describing the students' thoughts and gratitude regarding the donor bequeathing their body.
Kawashiro et al. 2009 [56]	Cross-sectional, descriptive	Japan	To evaluate whether exposure to cadavers in a laboratory setting influences PT students' attitudes towards such sessions. To evaluate whether exposure to cadavers in a laboratory setting influences PT students' beliefs about the dignity and value of human life.	An introduction to cadavers and dissection was given prior to the first laboratory session. It outlined ethical considerations Students were divided into groups of 11 students. Pre-intervention students completed a survey that included a demographic section. It had two questions pertaining to the students' pre-laboratory enthusiasm for this type of learning experience and their perceptions related to dignity and human life. Students rotated between four prosected cadavers, showing various human anatomical regions spending 20 minutes at each station. Lecturers offered assistance.	Responses came from 87 students (98.9%). Results for student enthusiasm for the laboratory sessions pre-intervention were recorded as: Sixty- two students (74.4%) had a positive attitude (mean score 5.52 ±1.28). Results for student enthusiasm for future undergraduate student laboratory attendance were: Eighty students (96.4%) were enthusiastic. There was a statistically different response between the pre-intervention response to the question about enthusiasm for laboratory attendance and that post-intervention regarding future laboratory attendance ($P<0.001$). The understanding of human body structure attained through the laboratory experience was highly rated by eighty-one students (97.6%) while two students (2.4%) chose option 3 on the Likert scale (No idea). With regard to the number of recommended future laboratory attendances by students: More than four times was favored by 46 students (55.4%), 23 students (27.7%) said four times was enough and 14 students (16.9%) felt that two or three times were sufficient. With regard to student opinions on human life and dignity pre-intervention: 10 students (12.0%) recorded low scores. After the intervention only one student (1.2%) recorded a low score.

				Cadavers 1 and 2 gave anterior views of the head, face, neck and upper limb and the trunk. Cadavers 3 and 4 showed a posterior view of the back, lower limb, cranial cavity and vertebral column. Post final laboratory session students completed a five-question survey	The difference in the responses pre- and post intervention were significant (P<0.001). The students' free comments about their laboratory experience indicated that 28 (students noted that their "understanding of the human body" had improved post intervention. Five students said that the experience had made them realize their "lack of knowledge of the human body." Positive emotions expressed by students included that the laboratory sessions provided: " Valuable experience" (21 students), "interesting anatomy" (3 students) " link to future learning" (2 students). Sixteen students wanted to " Take part in future laboratories." With regard to the donors "respect for donors" (4 students) and " belief about dignity" of donors (4 students) was mentioned.

IS: Interpersonal skills, P: Professionalism, PS: Problem solving, R: Responsibility, SD: Standard deviation, SM: Stress management

3.2.1.15 **Gaps in research identified by included studies**

Not all sourced studies identified gaps in knowledge or gave recommendations for future research but a number of studies did make important suggestions towards advancing and expanding this area of research.

In this regard with reference to an IPE intervention Hamilton et al. [26] suggested that such future experiments should be of a longer duration (> 8 hours), the intervention should not only be limited to a classroom but include the clinic setting and should include a group project. Sytsma et al. [25] said future research should address the structure and effect of IPE interventions as they pertain to various combinations of healthcare student populations working together. As per the suggestion of Reeves 2012 [48] they also suggested that assessment methodology should vary and endeavor to expand the way in which IPE is viewed. Furthermore, vertically integrated IPE interventions involving undergraduate medical and PT students working together where they have attained some clinical exposure should be undertaken and assessed. [25] Fernandes et al. [24] suggested that, as an adjunct to the IPE research, consideration should be given to follow-up focus groups and surveys using former participants who have entered the clinical healthcare arena. They argued that this would give a long-term perspective of the effects of the original intervention on participants' views on IPE and how it influenced their perceptions of other healthcare personnel. Furthermore, conclusions could be drawn when those results were compared to a survey of healthcare students who had not participated in the original intervention. These researchers also suggested, as per Lindquist and Reeves [49] that IPE course facilitators could be surveyed to gain their suggestions for improvement in such a programme from their perspective.

Shields et al. [50] recommended that future interventions to see whether IPE interventions improve the uptake of the clinical aspects of anatomy would translate into positive improvements in healthcare going forward.

In 1999 Berube et al. [31] believed that an investigation into how anatomy instructors (professors) were utilizing CAL to teach anatomy was warranted in the future. They also suggested an intervention where retention of anatomical knowledge would be measured in students who had learnt anatomy solely using cadavers and students who had learnt anatomy only using CAL. In the following two years the theme of the need for future research looking at the effectiveness of CAL on the retention of anatomical knowledge was further expanded. In 2000 Plack [30] evaluated the effectiveness of CAL as pedagogy in the short term but suggested that future

research should look at its long- term value with respect to anatomical knowledge retention. In the same year Anderson and Conley [51] looked at the longer- term effects and drew conclusions on retention of anatomical knowledge up to a year post intervention. They suggested that in the future such retention of knowledge should be linked to the amount of knowledge necessary to befit efficient and competent PT clinical practice. Furthermore, they suggested investigation into retention linked to further PT course inclusions that reinforce the initial learning. They suggested that not only the pedagogy used to teach students had to be examined but the timing of the introduction of anatomy knowledge into the curriculum also has to be considered. In 2002 Bukowski [29] again suggested measuring anatomy knowledge retention one year after a CAL intervention and determining the usefulness of supplemental material offered on an ongoing basis. Hence, the trend to keep recommending investigation into long-term retention of anatomical knowledge was continued. In 2005 Foreman et al. [52] suggested that the efficacious learning of anatomy and retention of that knowledge using the CAL tool they developed should be objectively examined further. In 2011 Thomas et al.[8] focused on the immediate retention of anatomical content and then recommended that more research should be done into the use of CAL and prosection interventions for DPT students to prepare them for future clinical application.

In the multimodal and blended learning category Ogard [33] introduced video dissection into an anatomy programme, and suggested that future research should look at the interrelationships between the different pedagogy utilized in an anatomy programme to see whether a cooperative interaction of components could lead to better learning outcomes for students.

Livingston et al [28] suggested future studies into team-based learning in DPT cohorts should follow a methodology using the same sequential time periods outlined in their study and compare outcomes of survey responses. They further put forward that survey research should include more DPT programs with team-based learning in place and also include prospective team-based learning opportunities in other DPT courses.

With regards to peer teaching Lake [44] suggested that research should be directed towards other courses outside gross anatomy looking at the influence of peer tutoring on student outcomes.

The category that garnered the most included studies was that of curriculum, pedagogy and materials. In a 1994 study Mattingly and Barnes [14] suggested that further evaluation of PT gross anatomy courses should occur taking into consideration: the use of cadaveric dissection and/or prosection and factors related to preservation of cadavers; the different ways of using CAL; the ability of staff to teach the clinical aspects of the course and the availability of texts and dissection manuals. Reimer et al. [13] who followed up on Mattingly and Barnes's work in 2013 felt that more research should be focused around the costs of running a cadaver laboratory. A South African study [53] modified the survey content and design of Reimer et al. [13] and collected similar data. The authors suggested that a future study should look at the breakdown of staff teaching gross anatomy to PT students in relation to the ratio of academic anatomists to anatomically competent PT clinicians. In this regard it should also assess the effect of these ratios on the teaching of the clinical aspects of anatomy. Furthermore the PT students' academic outcomes and the faculty throughput should be measured to determine the success of any gross anatomy programme. Khan et al. [54] who surveyed undergraduate PT students and qualified physiotherapists to gauge the importance of anatomy as a subject for their profession recommended that further research on the matter should be carried out using a larger survey sample size than the one they had used in their study. In a study carried out in 2015, Traser et al. [55] suggested that QR code research should be expanded to include other biomedical programmes and the repository of QR codes should be expanded to incorporate more elements of student learning. Furthermore, the opinions of course coordinators on whether or not QR codes are beneficial to them should be assessed. Research could also try and identify whether certain student groups defined by specific learning styles are more suited to QR code use.

No studies in the category of clinical input, case-based teaching and vertical integration offered suggestions for future research. However, with regard to ethical, professional and psychological matters Kawashiro et al. [56] after conducting a study evaluating student beliefs about the dignity and value of human life concluded that a larger study taking in more PT schools should be undertaken. They also suggested that further work should contrast how a laboratory or non-laboratory gross anatomy learning experience impacted on a students' ability to learn anatomy.

3.2.1.16 **Discussion**

It can be seen from the results of the literature search that 51 studies of the 1241 originally sourced between 1980 and 2018 were included in the scoping review. A cursory look at possible literature made it clear that the topic was broad and diverse.

The outcomes measured within the scope of the topic fell into the eight afore-mentioned categories.

The role of inter-professional gross anatomy learning in future physiotherapy clinical practice

"Inter-professional education refers to occasions when students from two or more professions in health and social care learn together during all or part of their professional training with the object of cultivating collaborative practice for providing client or patient-centered health care." [57] The World Health Organization (WHO) [58] reiterates the substance of this definition but adds that health care outcomes should be improved due to IPE and that IPE is "a necessary step in preparing a 'collaborative practice-ready' health workforce that is better prepared to respond to local health needs."

Evidence is growing that IPE for healthcare undergraduate students should be provided. [59-61] The relevance of IPE for students is linked to the mixture of disciplines involved in the intervention with them. The best and most positive student outcomes are seen when the professions taking part are closely aligned with each other. [62] In the seven studies in the IPE category of this scoping review the participating students were from medical and allied medical disciplines that PT students are likely to encounter post qualification so this augured well for a positive collaborative experience. [23-26,32,50,63] It is likely that physiotherapists during the course of their professional career will participate in a work environment where they either work as part of a multidisciplinary team or at least consult with members of other professions from time to time. Therefore, the opportunity where students from different disciplines learn together can foster awareness of other professionals' healthcare roles, garner respect between disciplines and embed respect for the other person's role as part of the healthcare team. [62] The use of teamwork appears to be integral to IPE learning and was seen across all seven of the scoping review studies. In the studies by Fernandes et al. [24] and Sytsma et al. [25] teamwork and collaboration were specifically measured with both showing positive outcomes and high importance. In particular, the need for respect and trust was rated highly. [25,26]

Three interventions combined the use of IPE with peer teaching experiences [24,25,50] and all seven included horizontal integration of clinical techniques within the anatomy course. Hamilton et al. [26] showed that a physiotherapist was not considered to only function in a supporting role to the doctor and PT students felt that IPE enhanced

understanding of clinical problems. Mitchell et al. [32] showed that PT students performed very well in examinations after such an intervention and the exercise gave them insight into teamwork between the professions for future clinical practice.

Relevance of the duration of inter-professional studies

It has been shown that learning in smaller groups and the use of problem-based learning in such circumstances is beneficial. [60] All seven of the IPE studies used small group teaching. Abu-Rish et al. [60] in a study pertaining to healthcare students found that the majority of IPE interventions had been single events of less than five years duration. They suggest that for the relevance of such information to direct change in teaching practice studies should be of longer duration with longitudinal follow-up. The studies in the IPE category fell into the same short term pattern described by Abu-Rish et al.[60] with the exception of the study carried out by Fernandes et al. [24] where the study lasted for ten weeks and was thirty hours long. Furthermore, that study reported a qualitative one-year follow-up where respondents expressed a desire to work with other professionals more often.

The effectiveness of various combinations of computer-assisted learning and traditional gross anatomy pedagogies

In this day and age technology is playing an increasing part in the teaching of anatomy. The 3D aspect of anatomy education in relation to CAL has been described. [64-66] Trelease [67] put forward that dissection might be simulated and Codd and Choudhury [68] suggested CAL to compliment traditional teaching pedagogy to give a 3D perspective. In this respect Bukowski [29] and Plack [30] compared traditional gross anatomy teaching methodology to programmes incorporating CAL with a lack of cadaveric dissection. Bukowski [29] concluded that a blend of traditional lectures and CAL was beneficial to the learning of gross anatomy by PT students. Plack [30] used a two-way comparison where in one group traditional dissection with lectures was the methodology followed and the other group was given CAL, slides and videos together with prosection observation. Both of the previously mentioned researchers concluded that CAL instruction was as effective as traditional methodology for gross anatomy education. Contrarily Berube et al.[31] showed that there was a strong preference for traditional dissection (96.9%) in programmes. This latter finding seemed to possibly be related to the fact that when the study was conducted in1999 computer usage was only in 60.9% of programmes. However, a much later Indian study, although finding CAL a useful adjunct to traditional anatomy teaching, found that students still felt that CAL could not replace traditional cadaver dissection.[69] Perhaps the solution is to keep the traditional methodology but enhance it with CAL technology. In this regard

Elizondo- Omaňa et al. [70] found that a group of anatomy students using traditional methods only had an average final examination grade of 58(±14.9) compared to 68(±14.6) for those students that had a combined traditional and CAL course format.

The role of computer-assisted learning in retention of gross anatomy knowledge

An important consideration for anatomy learning is whether pedagogy like CAL will improve the retention of information by a student. Thomas et al. [8] looked at the introduction of CAL into a gross anatomy programme for master of occupational therapy students and DPT students. The researchers concluded that students remembered anatomical structures and could draw them from memory better after the intervention. The same improvement occurred with the recall of relationships between anatomical structures post intervention. The authors Anderson and Conley [51] saw a similar retention of anatomical information even six months and a year after introducing a CAL programme for nine different anatomical regions and systems. In 1992 a RCT was used to gauge the effectiveness of the introduction of CAL via an ICAL package. [71] The researchers concluded that such an intervention helped the retention of anatomy and identification of surface anatomy landmarks. They also concluded that it was feasible and cost effective to use this methodology for the teaching of gross anatomy to PT students as the use of the ICAL packages could result in the acquiring of the 2D knowledge necessary for 3D application in surface anatomy sessions.

Is it beneficial to teach neuro-anatomy using computer-assisted learning?

Elizondo-Omaňa et al. [70] found that a neuro-anatomy student group also benefited by using a combined traditional and CAL course structure and McKeough and Bagatell [72] and Foreman et al.[52] reported on the use of CAL for the teaching of neuro-anatomy to PT students. Both of the latter studies found beneficial outcomes. In Foreman et al. [52] 95% of the respondents found the tool was much to somewhat better to use than traditional anatomy learning tools.

Personalization of computer-assisted learning programmes in gross anatomy

Learning by means of CAL can be personalized to the needs of the individual using it, is generally accessible when needed and use can be tapered to the pace of the individual student. [38] This is perhaps an unreasonable assessment of the situation if the student is using CAL in the classroom scenario and has to complete certain tasks

in a specific time frame. However, Janssen et al. [21] concluded that CAL, customized for specific group users such as allied health students, was preferable to generalized gross anatomy CAL content.

The case for the use of blended learning

According to Proctor [73] blended learning is "the effective combination of different modes of delivery, models of teaching and styles of learning." As already stated anatomy education faces an ever-growing shortage of teaching hours. [5,74] Hence, the use of a combination of pedagogy with both face-to-face contact and online options, such as found in the blended learning approach, may be the answer to this problem. [75] Sayek et al. [76] recommended that such alternative strategy should be used more frequently in anatomy education.

In this scoping review it was seen that a group of researchers in Australia had conducted quite extensive research into the use of the blended learning approach in PT undergraduate student populations. In this regard Green and Hughes [77] and Green et al.[78] reported on blended learning using asynchronous online discussion groups as an adjunct teaching method to that already in place in the Australian gross anatomy programmes. These researchers drew conclusions based on the number of 'hits' on an asynchronous online platform by first and second year undergraduate PT students. They found that second year students who contributed most to the forums obtained higher final examination marks.

In 2016 Green and Whitburn [34] described a progressively incremental blended approach to the teaching of gross anatomy with more video material being introduced over a three-year period. This was achieved with more than 50% of the face-to-face lecture time being replaced by online interactive videos. The overall face-to-face time decreased from 60 hours in 2013 to 45 hours in 2015. The researchers found that the mean written and practical examination marks for 2014 and 2015 were higher than in 2013.

Kharb and Samanta [79] using a blended learning approach for three anatomical topics found that medical students reported an increased interest in the subject while developing a more independent learning attitude. Students also interacted better in face-to-face sessions with instructors and gained a better understanding of anatomy. The design of the blended approach tested by Green and Whitburn [34] did encourage a more independent learning approach from the students but the researchers did

emphasize the need for face-to-face interaction to still take place between students and lecturers. Three negative aspects of the latter study were that students found the workload to be heavy and not necessarily appropriate and in 2015 overall satisfaction with the programme was slightly lower than in the previous two years. Furthermore, a great deal of time was needed for lecturers to design and set up the blended teaching format. Hence, perhaps it is not the use of technology that can lead to differences in outcomes of this type of intervention but it is the way in which the pedagogy is implemented to suit the particular requirements of specific student groups. [80]

Ogard [33] used the introduction of the observation of online video dissections to replace some of the time spent on cadaveric dissections. Following the intervention an increase in the understanding of anatomy content was reported due to the viewing of video dissection material. As per what was found by Kharb and Samanta [79] it appears that students in this study benefited regarding understanding of the course content from discussing the video content face to face with instructors. Ogard [33] additionally helped to develop professional attitudes due to clinical integration. Interestingly although the students in both this study and the Green and Whitburn [34] study enjoyed the blended learning experience they expressed a preference for cadaveric dissection for learning and understanding gross anatomy.

Green et al.[35] in a recent study, evaluated by means of a structural equation model, the relationship between higher student scores on a prerequisite anatomy principles course and a higher final course mark for the second year anatomy course. They found a positive relationship between these factors. They also discovered that better final learning outcomes were positively correlated with student participation in online video observation and interaction with peers in online discussion groups.

The pros and cons of using multi-modal learning

Multi-modal learning incorporates the learning of a subject through many different sensory modalities. [81] It is useful as a learning tool as it appropriates to the different learning styles of students. [81] Hence, the multitude of ways presented to assist with learning a subject can lead to better learning, understanding and retention of study material. [82] However, it is important that in the execution of multi-modal learning the student is not bombarded with too many modalities leading to overload and overstimulation with resultant lack of absorption of the necessary information. [81] It is suggested that modalities are presented in a structured and organized way and activities are rotated in short 15-20 minute segments. [81]

This scoping review found that Nicholson et al. [83] described an innovative multi-modal interactive workshop. The components of the workshop were designed to stimulate the use of different learning styles of a visual, auditory and kinesthetic nature. The researchers found that students favored an overlap of learning styles with the visual/kinesthetic type being most favored. Bearing in mind the previously stated considerations for successful blended learning this workshop was a once off four-hour duration intervention. Although the students could move freely between the four modalities offered to assist with their learning of the upper limb this seems to be a little out of line with the suggestion of structured, organized 15-20 minute modality stations. However, participants did perform better in examinations than the non-participants and qualitatively attendees appeared to understand subject content better after the intervention. Body painting and clay modeling appeared to be the most popular modalities and this would relate well to the tactile nature of PT work.

The value of team-based learning in combination with peer teaching/ mentoring/ tutoring

As the name suggests team-based learning involves the placing of learners into structured, specific groups that are made up of a small number of individuals. The prerequisite for participation is that the student prepares for the group interaction and then applies and shares knowledge with the other participants within the group setting. [84] Questions arising from the sessions further help the student with the understanding of the subject. [84] In team-based learning peer feedback and discussions between teams add to the volume of knowledge available. [27] Peer learning and peer teaching describe situations where students in groups collaborate and cooperate with each other as self-directed, active and equal participants. Discussion with relevant feedback on shared intervention experiences forms part of the interactive process. [85] As has been already stated there was some overlap in the defined categories and this was noticed in particular where team-based learning incorporated peer tutoring/ mentoring or teaching within the smaller groups or teams. Huitt et al. [27] aimed to see what happened in the experimental student sample when a half of the cadaveric dissection time was taken up with a team-based intervention. Peer teaching was also incorporated into the experience where the comparison group, who had used the traditional gross anatomy learning format taught the team-based group the dissection and the team-based group linked it to clinical scenarios. Academically the team-based programme improved students' performance. The researchers felt this was because the program encouraged deeper learning and

examination preparation. Deeper learning has been associated with better academic results and is therefore preferable. [86]

It has been documented that peer teaching can have an important positive impact on both the peer learners and the peer teachers. [87] This was noted in the study by Youdas et al. [41] where peer tutors found that the peer teaching experience had help them to apply anatomy in the musculoskeletal PT classroom. In a review of studies pertaining to peer teaching and learning Secomb [88] concluded that such studies showed that these methodologies encouraged improvement in learning outcomes. Livingston et al. [28] held student peer teaching and case discussions for DPT students, over three chronologically consecutive cohorts, for the teaching of specific joint complexes. This resulted in gross anatomy grades for all three cohorts being above average and students preferring team-based learning to lectures. Youdas et al. [89] introduced peer review sessions into a DPT gross anatomy curriculum. In these sessions the first year students were given learning packs and were encouraged to discuss and think critically about the provided information. Post peer review quiz results and examination scores improved and 78.6% and 64% of students respectively felt that this was due to the intervention. Lake [44] reported that in a peer tutoring intervention where fifth year professional PT students tutored first year students there was a positive correlation between the number of times a student had attended the voluntary tutoring courses and marks achieved.

In reciprocal student peer teaching/tutoring interventions participants alternate between the role of learner and teacher and are similar age and learning the same subject. The process is student driven and the students are involved in both the preparation and design of the intervention. Feedback from the peer group is immediate. [90] Youdas et al.[42] tested this reciprocal peer teaching where intervention groups were required to demonstrate a dissection to their peer group once a week on a reciprocal basis. The median anatomy course grade for the intervention groups was significantly better than for the non-intervention group.

Wait et al.[40] evaluated perceptions of first year DPT students regarding the use of an audience response system in gross anatomy peer teaching. The peer teachers were second year students. The first year students found that the audience response ‘clicker’ use helped them realize how well they understood a topic by giving immediate feedback. Overall the intervention was rated as conducive to deeper learning of anatomy and good for peer group interaction. As already mentioned deeper learning is desirable for its association with better academic results. [86]

Peer mentoring occurs where a person who has already undergone a certain experience assists, encourages and at times challenges a mentee to fulfill a certain level of attainment of relevant knowledge. Peer mentoring and team-based learning can be inclusive if the members of the team are a peer group of students and they teach each other. De Oliveira et al.[43] looked at peer mentoring in an IPE setup where the student mentors shared their anatomical knowledge with their peers by demonstrating anatomical structures on prosected cadavers. The researchers reported that attendees performed better in examinations. In all seven of the studies that incorporated the team-based and peer tutoring/mentoring /teaching elements a common dynamic was that the intervention group was divide up into smaller groups.

What are the important inclusions in curricula, pedagogy used to teach gross anatomy and materials used in anatomy programmes?

Fourteen studies were sourced that dealt with matters relating to pedagogy, [7,13,42,91-94] curriculum, [14,17,54, 91, 92] and materials [55,94-96] used in gross anatomy education for undergraduate PT students. In some instances there was an overlap between teaching methodology, materials used, relevance of anatomy, curricular inclusion and the use of peer teaching or team-based learning. Surveys were used to collect data regarding curricular and pedagogical factors either prospectively or retrospectively in the majority of studies.

Pedagogy used in the teaching of anatomy mentioned across the included studies is plentiful and diffuse. In 1994 Mattingly and Barnes [14] stated that the majority of gross anatomy programmes in the USA used dissection. In 2013 a survey of PT schools in the USA, that used the 1994 Mattingly and Barnes [14] gross anatomy survey as a template, noted a slight decrease in the use of dissection from 100% in 1994 to 92.6% in 2013 but noted that other pedagogy, particularly the use of CAL had increased exponentially between 1994 and 2013.[13] A comparison of the amount of dissection offered in the USA and Canada by Armstrong and Rosser [89] in 1996 showed that in Canada the emphasis was placed on the use of prosection and in the USA the emphasis was on dissection or a combination of the two pedagogies. In 2012 general PT respondents and expert PT respondents to an American survey by Gabard et al. [7] reported that an average of 60.3% and 67.9% of time respectively was spent in cadaveric dissection while dissection was favored by 71.3% of respondents to a survey held in Pakistan in 2015. [54] A 2016 survey held in South Africa reported that 67% of the responding faculties had dissection. [53] However, it was often

combined with prosection and one faculty only offered prosection (17%). The Gabard et al. [7] survey produced a future projection on the topic where general PT respondents felt that by 2020 there would be a possible 13% decline in the current percentage of time spent in dissection practical sessions. McKenzie and Guterriez [92] reported on a study of the concept of 'Capstone projects' where second year DPT students had to choose a particular anatomy topic, research it and then carry out a detailed dissection on their cadaver while presenting the project to small groups of classmates. Some students found the experience beneficial because of the independent nature of the learning process and the collection of a good body of project work for future professional reference. Others found the preparation time consuming and the presentations daunting. In a Spanish study PT students rated the use of anatomical models for the learning of anatomy very highly across both cohorts. [97]

Unique pedagogies introduced to try and give innovative perspective to the learning of gross anatomy were the use of body painting exercises to enhance a surface anatomy experience of the lower limb [96] and a 'muscle cut out exercise' (MCOE) that included selected muscles of the upper and lower limbs. [95] The former intervention was done over a period of 40 minutes and was well received and enjoyed by the students. It was felt that with adequate planning the fact that it was time consuming could be addressed. The latter intervention only took 15 minutes but the preparation for the session was lengthy. It was used as a 2D preparation for a 3D dissection experience. A further innovative intervention was the incorporation of QR codes to assist in the learning of gross anatomy. [40] A comment such as " Quick and easy way to test myself even if I didn't have a study partner or instructor around" show that QR codes are useful for independent learning and for examination preparation.[40]

Pabst [98] stated that there are more questions than answers when it comes to decisions about what should be considered for inclusion in an anatomy curriculum. He concluded that global borders and the vast array of institutions where anatomy is taught and methods of teaching the subject make it difficult to suggest what would be the best way forward for future curricular design. He recommended that long-term studies should be carried out to try and address the impasse. This scoping review revealed that in order to establish curricular information about PT gross anatomy programmes Mattingly and Barnes [14] distributed a 92-question survey to 145 PT programmes in the USA. The majority of institutions surveyed were public (54%) with 47.7% of the gross anatomy programmes linked to an allied health school and 13.8% associated with a medical school. Reimer et al. [13] updated many of the 1994 survey findings, commented on their own findings and compared their results with those

obtained by Mattingly and Barnes. [14] In 1996 Armstrong and Rosser [91] compared gross anatomy curricular inclusions in the USA and Canada. These researchers questioned the need for incorporation of more PT anatomists in programmes and also the changing of anatomy textbooks to ones that included more clinical examples.

The reasoning behind the incorporation of clinical input in gross anatomy programmes for physiotherapy students

In 2001 Latman and Larnier [17] concluded that the gross anatomy curriculum for health sciences students should be directed towards preparing such students for the specific professional clinical practice that they aspired to and because of that consideration should be given to the inclusion of PT clinicians to teach PT students anatomy.

With respect to the relevance of learning anatomy for clinical practice Collins [99] stated that: “The objective of learning anatomy is to integrate an understanding of normal function with recognition of normal structure.” This statement was qualified by identification of the need to teach anatomy in a clinical context in order that students understood the content, could retain what they had been taught and then could apply that knowledge to the challenges presented in professional, clinical practice. [100-103] In particular gross anatomy was found to be of fundamental importance as far as its relevance to daily clinical practice in a survey conducted by Arráez-Aybar et al. [104] In this regard Khan et al. [54] found that DPT students felt that gross anatomy was a key component in their training for future clinical practice and first year PT students in Spain felt that it was highly appropriate for their degree course. [43] However, another Spanish study only rated the interrelationship between anatomy and future clinical practice at 3.4 on a five point Likert scale. [93]

First and second year DPT students introduced to the Varied-Integrative-Progressive (VIP) approach to learning gross anatomy with both horizontal and vertical integration over the entire anatomy curriculum felt that work produced in their own and peer projects could be collected and used for reference in future clinical practice. [92] Latman and Larnier [17] surveyed the views of PT clinicians among others and found clinicians felt that beneficial outcomes in the clinical scenario were more likely with the early introduction of gross anatomy in a health science course. However, they did feel that the focus brought to the learning of anatomy by clinical exposure was essential and that an ancillary course linking the two factors might be a beneficial solution to the problem.

Physiotherapy has a tactile component to its delivery of clinical services. Two of the studies in the clinical input category exposed students to a ‘hands on’ experience of testing a joint on a lightly embalmed cadaver. The Lachman test was performed on the knee joint by first year IPE students from three different disciplines in the study by Janssen et al. [21] Krause et al. [22] included tests for the knee, ankle, shoulder, elbow, hand and thumb joints for second year DPT students. In both studies the students benefitted from the clinically integrated experience and in the Krause et al. [22] study the researchers found that 91% of the students felt that the experience had helped them learn anatomy better.

Case-based learning can play a part in early clinical exposure and be incorporated into an anatomy programmes by means of vertical integration

Early clinical intervention can give the PT student visual input regarding medical conditions. The neuro-anatomy study by Prithishkumar and Holla [20] introduced PT and OT students to early clinical exposure where four patients with neurological conditions were presented to the students. A student in this study commented ”since we can see the condition for ourselves, it is useful to retain memory of the subject.” [20] Suggestions arising from this experience were that the students wanted this type of exposure to clinical cases for other regions of the body. The students rated the learning experience as either good (75%) or excellent (25%). [20]

In anatomy education if vertical integration is applied it is usually integrated into the area of basic sciences such as anatomy where clinically relevant facts are incorporated into the course curriculum. Wisco et al. [105] suggested that anatomy should be integrated into the clinical years of a medical education curriculum. One of the ways in which this vertical integration takes place is through the presentation of clinical case information in lectures, tutorials or practical sessions. In this regard Parmar and Rathinam [100] re-introduced fourth year PT and OT students to a gross anatomy intervention consisting of lectures and demonstrations with prosected cadavers for certain areas of the body associated with respiratory anatomy. Students were also given a clinically relevant case at the end of the first session and the relevance of anatomy to the case was discussed. The researchers reported that the students would have liked to spend more time on case-based learning and 93.8% of students felt that the intervention improved the learning of anatomy. The majority of the students felt that case-based learning should be integrated from the first year of an anatomy programme. This latter finding was in line with that of Singh and Bhatt [106] who introduced medical students to case-based learning in the first year of their

anatomy programme and found that it initiated student learning, helped them understand the practical application of the theory and improved their problem solving abilities. These researchers also noted that the facilitators of their anatomy programme felt that it was feasible to introduce case-based learning and combine it with lectures.

The relationship of anatomy dissection to the development of professional behaviour in physiotherapy students

Böckers et al.[107] found that dissection was instrumental in the positive development of professional behaviours in undergraduate medical students. They attributed the feelings of professional competency by such students to the general appreciation of having the opportunity to dissect a human cadaver. Similarly Cho and Hwang [108] suggested that the dissection laboratory was a good place to foster the development of professional behaviour. However, contrarily Sbayeh et al. [109] found that medical students were less likely than professional practitioners or anatomy instructors to find that anatomy education improved their views on professional conduct. In this scoping review Youdas et al.[88] assessed individual and peer feedback for DPT students who had participated in dissection sessions. They compared the differences in the scores for ten professional PT behaviours pre-intervention and post intervention. The intervention was a one-on-one feedback session with a lecturer who gave the student numerical scores from previous individual and peer assessments, offered students praise if they showed an understanding of the concept being tested and encouraged those that needed to improve. The researchers saw a significant improvement in professional behavior by the students in the final week of the gross anatomy course.

The relevance of the "donor's gift" and realization of the dignity of human life to professional development in physiotherapy students

In a study carried out with medical and allied health science students Lazarus et al. [110] looked at the reflective, creative writings of the students in relationship to the students' attitudes towards learning gross anatomy using dissection. The researchers found that the students expressed themselves in an open and genuine way and it helped them associate their dissection experience with clinical scenarios. In this scoping review Canby and Bush [111] introduced a "Humanities in gross anatomy" (HuGA) project by giving a lecture to the first year DPT students prior to the commencement of dissection. At the end of the gross anatomy programme the students were asked to document their experiences with reference to behavioural and

humanistic parameters. This was with respect to the “donor’s gift”. Students were given a number of different options to express their feelings. The results showed that students felt positively about their experience and there was professional and humanistic growth as a result of this.

Although only a half of the medical students surveyed by Cho and Hwang [108] post their dissection experience expressed an appreciation for human dignity and a fewer reflected on life and death these results were considerably higher than those seen pre-intervention. Kawashiro et al.[56] looked at how PT students in team-based learning groups reacted to their experience of the observation of prosected cadavers in relation to dignity and human life. Students expressed positive emotional responses to this experience and said that they felt that their understanding of the human body had improved. All three of the afore-mentioned experiences associated with PT gross anatomy teaching methodology also showed some positive professional development in the student body undergoing the experience.

3.2.1.17 **Conclusions**

The objective of this scoping review was to collect and describe the available literature pertaining to the curricular design and pedagogy used to teach undergraduate PT students’ gross anatomy. The first research question also related to the content of the literature regarding the topic of the objective. In this regard, after a systematic search of the afore-mentioned databases, 51 studies were included in this scoping review as they offered a window into many aspects of how gross anatomy is taught to this student body. The results highlighted that there are numerous factors to consider when deciding what pedagogy, learning programmes and organizational models should be used to deliver anatomical knowledge to PT students.

In answer to the second research question that looked into the various methods of delivery of aspects of anatomy education in more depth the results of the seven IPE studies conducted between 2004 and 2018 suggested that the use of IPE in conjunction with other teaching methods offered students the opportunity to experience teamwork with other professional disciplines in preparation for their future roles as clinical professionals. The CAL studies illustrated that it is not the impressiveness of the CAL programme that counts but its relevancy to the student group receiving it. Hence, it is perhaps most important to realize that the content of such a programme for PT students should be appropriate to their course objectives and be presented in such a way as to stimulate their learning of the subject. Overall

the two described approaches of multimodal and blended learning encouraged student-centered learning and integration in line with a problem-based learning type of teaching model.

Outcomes seem to suggest that the general format of peer teaching with the integration of team-based learning is a beneficial method of teaching gross anatomy and should therefore be considered for incorporation into a gross anatomy curriculum for PT students. The outcomes of this study pertaining to the identification of plausible, beneficial and implementable curricular and pedagogical align with the required overall outcome of the thesis as described in Chapter 1.

The importance of considering the impact of dissection and/or prosection on the student psyche and its impact on anatomical learning and the resultant development of professional behaviour patterns, ethical considerations and an appreciation of the dignity of human life were also highlighted in the sourced studies.

3.2.1.18 **Recommendations for research**

This scoping review highlighted that the majority of studies (88.2%) were carried out in economically well-developed countries such as the USA, Canada, Germany/Switzerland and Australia. Six (11.8%) of the studies were carried out in countries that have less well-developed economies (Brazil, India, Pakistan and South Africa) and this may have a bearing on how relative some of the suggested educational implementations are to faculties that are not well funded. Hence, it is important that more studies are conducted in less economically viable countries to garner a more balanced perspective on what is being offered for PT gross anatomy education globally.

3.2.1.19 **Recommendations for practice**

It was seen that case-based learning in a horizontally or vertically integrated manner has advantages to the learning and understanding of anatomy to prepare for clinical competency. Furthermore, studies on professional behaviours and humanistic and perception of dignity for human life seem to indicate that there is an inherent value in maintaining the more traditional dissection or prosection aspects of gross anatomy education in order to ensure students carry forward the respect and dignity learnt in the dissection hall to their future patient care.

3.2.1.20 **Conflicts of interest**

There is no conflict of interest declared with regard to this research.

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APPENDIX 1

SEARCH STRATEGIES FOR DATABASES (20/03/2018)

Scopus (Advanced search)

		Document Results
1.	ALL (education OR learn* OR teach* OR exam* OR test OR e-learn* OR online OR course OR pedagogy)…….	23,178,006
2.	Gross AND anatomy OR morpholog* AND anatomy……..	97,845
3.	Undergraduate OR pre-graduate OR student OR trainee……..	1,787,228
4.	Health AND profession OR health AND science* OR allied AND health……...	5,510,545
5.	Physical AND therapy* OR physiotherapy……	988,652
6.	1 and 2…….	60,795
7.	6 and 3…….	6,256
8.	7 and 4…….	3,633
9.	8 and 5……	1,035

EBSCO (Academic Search Complete, CINAHL, Education Research Complete, ERIC, MEDLINE) (Advanced search)

		Document Results
1.	X education OR TX learn* OR TX teach* OR TX exam* OR TX test OR TX e-learn* OR TX online OR TX course OR TX pedagogy)……..	10,913,798
2.	X Gross AND TX anatomy OR TX morpholog* AND TX anatomy……	87,218
3.	X Undergraduate OR TX pre-graduate OR TX student OR TX trainee	1,286,125
4.	X Health AND TX profession OR TX health AND TX science* OR TX allied AND TX health…….	192,719
5.	X Physical AND TX therapy* OR TX physiotherapy……	147,746
6.	1 and 2…….	34,075
7.	6 and 3…….	3,177
8.	7 and 4…….	850
9.	8 and 5……	147

PubMed (Advanced Search)

		Document Results
1.	Education OR learn* OR teach* OR exam* OR test OR e-learn* OR online OR course OR pedagogy…….	6,594,231
2.	Gross AND anatomy OR morpholog* AND anatomy……..	345,442
3.	Undergraduate OR pre-graduate OR student OR trainee……..	297,268
4.	Health AND profession OR health AND science* OR allied AND health……...	971,599
5.	Physical AND therapy* OR physiotherapy……	856,535
6.	1 and 2…….	106,581
7.	6 and 3…….	1,303
8.	7 and 4…….	217
9.	8 and 5……	35

JBI Database of Systematic Reviews and Implementation Reports

		Document Results
1.	Advanced search for the terms gross AND anatomy. ……..……...	122
2.	Advanced search for the terms gross AND anatomy AND undergraduate physiotherapy student education.....	1

Cochrane Database of systematic reviews

		Document Results
1.	Advanced search for gross AND anatomy……	10,285
2.	Advanced search for the terms gross AND anatomy AND undergraduate physiotherapy student education…….	1

CHAPTER 4

4.1 PAPER 3

Shead DA, Roos R, Olivier B, Ihunwo AO 2018 Gross Anatomy Education for South African Undergraduate Physiotherapy Students. Anatomical Sciences Education Journal: Accepted 29 November 2017 and published online January 2018.

Journal: Anatomical Sciences Education

Journal Details: Anatomical Sciences Education is an open access journal of the American Association of Anatomists, published in cooperation with the American Association of Clinical Anatomists and the Human Anatomy and Physiology Society and received International Scientific Indexing (ISI) recognision.
The aim of this journal is to facilitate the share of information related to gross anatomy, embryology, histology and neurosciences at all levels of anatomical sciences education.
The Anatomical Sciences Education journal has an impact factor of 3.114.

The formatting of the content of this thesis paper is aligned with the publication requirements of the specific journal. The tables and figures have been inserted at the appropriate position in the paper and have been numbered in accordance with the thesis formatting.

4.2 ORIGINAL PAPER 3

4.2.1 Title: Gross Anatomy Education for South African Undergraduate Physiotherapy Students

Authors: Dorothy A Shead, Ronel Roos, Benita Olivier, Amadi O Ihunwo

4.2.1.1 Abstract

Eight faculties in South Africa offer undergraduate physiotherapy training with gross anatomy included as a basis for clinical practice. Little information exists about anatomy education for this student body. A 42-question peer-reviewed survey was distributed to physiotherapy gross anatomy course coordinators in all the eight faculties. Seven coordinators from six (75%) of the universities responded. Two respondents' data from

the same university were pooled. Collected data show that staff qualifications and experience varied widely and high to average staff to student ratios exist between faculties. Direct anatomy teaching duration was 12.3 (SD 65.2) weeks per semester. Total number of weeks in courses per faculty was 27.6 (SD 65.7) varying widely between institutions. Calculable direct contact anatomy hours ranged between 100 and 308 with a mean of 207.6 (SD 678.1). Direct contact hours in lectures averaged 3.9 (SD 61.6) per week and the average direct contact hours in practical sessions were 3.5 (SD 61.8) per week. Dissection, prosection, plastinated models, surface anatomy, and e- learning were available across faculties. Ancillary modalities such as vertical integration and inter-professional learning were in use. All faculties had multiple-choice questions, spot tests, and short examination questions. Half had viva-voce examinations and one had additional long questions assessment. Students evaluated teaching performance in five faculties. Four faculties were reviewing anatomy programmes to consider implementing changes to anatomy curriculum or pedagogy. The findings highlighted disparity between programmes and also identified the need for specific guidelines to develop a unified South African gross anatomy course for physiotherapy students.

Key words: gross anatomy education; undergraduate education; physical therapy education; physiotherapy; allied health; anatomy curriculum.

4.2.1.2 **Introduction**

Throughout history medical education has had a strong anatomical component (Papa and Vaccarezza, 2013). The teaching of anatomy in South Africa began in 1911 at the South African College, later called the University of Cape Town (Correia et al., 2013). In 1919, an anatomy department was started at the South African School of Mines and Technology that later became the University of the Witwatersrand (WITS) (Correia et al., 2013). The Department of Physiotherapy at WITS has the oldest physiotherapy (PT) programme in South Africa: a three year diploma in PT was offered from 1938 but in 1943 the four-year degree was established under the leadership of Raymond Dart, an anatomy professor and Dean of the Medical School at WITS from 1925 to 1943 (Tobias, 2007; Myezwa et al., 2013). Thereafter, anatomy became consolidated in the undergraduate PT course.

After pioneering beginnings at WITS other universities began to establish PT courses with anatomy as a compulsory inclusion. The University of Pretoria and University of Cape Town's first PT diploma intakes occurred in 1950 and 1957 respectively

(University of Cape Town, 2017; University of Pretoria, 2017). The Sefako Makgatho University, formerly the Medical University of South Africa (MEDUNSA), and the University of KwaZulu - Natal introduced a PT course for students of colour in 1979 (Mbambo, 2004; University of KwaZulu-Natal, 2017).

All degrees are now standardized to four years duration and the timing for inclusion of anatomy in the course curriculum varies between faculties.

Anatomy is taught to physiotherapy students in their first year at the University of Pretoria, the University of the Free State and the University of the Western Cape. At WITS, Sefako Mekgatho University and the University of Kwa Zulu-Natal it is taught in the second year while at the University of Cape Town and Stellenbosch University it is taught over the first two years of the degree programme.

Visually impaired undergraduate PT students are trained at the University of the Western Cape (University of the Western Cape, 2017).

When considering the teaching of human anatomy and the factors that may influence it is important to note that, in the international arena, it is reported to be influenced by less available instructional time caused by increased student- centered anatomical education (Drake et al., 2009, 2014). The basic anatomy content for medical students has not decreased and the students have to undertake the learning of it in less time (Pawlina and Drake, 2017). It has been shown that this decrease in time has not impacted negatively on the medical student's ability to understand and remember basic anatomical concepts (McBride and Drake, 2016). In the case of PT gross anatomy education, there is evidence that in 1994 the traditional format for teaching anatomy to PT students was used and was similar to that taught in medical schools (Mattingly and Barnes, 1994; Drake et al., 2009). However, further definitive description of the impact of the time constraints on PT students' anatomy learning has not been documented.

The reasoning behind the manner of teaching anatomy to medical students to emphasize its relevance for retrieval, application and retention in clinical practice has been reported (Pawlina and Drake, 2016, 2017). Physiotherapy is a clinical profession where professionals aim to maximize clients' ability to move and function when clients have been affected by ageing, physical injury, diseases and disorders (WCPT, 2016). A high standard of gross anatomy knowledge is thus vital for these professionals to enable them

to evaluate normal movement effectively and identify abnormality. A gross anatomy curriculum for undergraduate PT students should thus be clinically relevant to PT practice (Johnson et al., 2012; Moxham et al., 2014). It should also be taught in a manner that helps the PT students retrieve, apply and remember anatomical content to enable best clinical practice. Aspects to consider when developing anatomy teaching are the role of said professionals, course content and type of pedagogy (Kleibard, 1989). Many types of anatomy pedagogies are used to improve the anatomical learning experience (Sugand et al., 2010). Pedagogies used in undergraduate PT education include: dissection (Pawlina and Lachman, 2004; Kramer et al., 2008; Gabard et al., 2012; Torres et al., 2014; Khan et al., 2015); prosection (Topp, 2004; Patel and Moxham, 2008) inter-professional education (IPE) (Shields et al., 2015; Sytsma et al., 2015), online discussion forums (Green et al., 2014), blended learning (Green and Whitburn, 2016), multi-modal models (Nicholson et al., 2016), and peer teaching (de Oliveira et al., 2015; Sytsma et al., 2015). A unique and innovative addition to the list and a South African contribution was the use of a “cut out and paste” way of teaching spatial gross anatomy relationships (Gangata, 2008). Benefits of pedagogies chosen are diverse. Youdas et al. (2013) reported that dissection enhanced professional behaviours in first year doctor of physical therapy (DPT) students. Inter-professional education models that include team collaboration have resulted in improved academic performance (Huitt et al., 2015; de Oliveira et al., 2015; Nicholson et al., 2016); enhanced clinical problem solving (Sytsma et al., 2015); better understanding of the roles of other healthcare providers and increased interest in and ability for teamwork between professional groups (Livingston et al., 2014; Shields et al., 2015). Asynchronous online discussion forums demonstrated improved student- learning outcomes (Green et al., 2014) and blended learning methods proved beneficial when students retained face-to-face practical sessions (Green and Whitburn, 2016). The “cut out and paste” exercise helped students with their three-dimensional (3D) visualization of anatomical structures (Gangata, 2008).

There is a paucity of literature reporting on gross anatomy education, specifically for undergraduate PT students in South Africa. The gaps in the literature point to the need to establish aspects of the current gross anatomy education for this student population. The aim of the study was thus to describe the current gross anatomy staff demographics, staff to student ratios, teaching methods and resources available as they pertain to gross anatomy education programmes for undergraduate PT students at health sciences faculties in South Africa.

4.2.1.3 **Methods**

A cross-sectional, observational, survey-based study was undertaken. The sampling was specific and limited to gross anatomy course coordinators for undergraduate PT students at the eight South African health science faculties that offered a PT programme during the 2016 academic year. This purposive, expert sampling was chosen as the information that was to be collected by the survey was best gleaned from the course coordinators. The Head of Department (HOD) or School (HOS) of Anatomical Sciences was approached to help identify the gross anatomy coordinator for the PT students in their faculty. Permission was then sought from the HOD or HOS to approach the coordinator with an invitation to participate in the survey. The health science faculties were at the following Institutions, Sefako Makgatho University, Stellenbosch University, University of Cape Town, University of the Free State, University of Kwa Zulu Natal, University of Pretoria, University of the Western Cape and WITS. Ethical clearance for the study was given by the Human Research Ethics Committee (Non-Medical) of the University of the Witwatersrand in Johannesburg, South Africa. The Anatomical Society of Southern Africa (ASSA) granted permission for data collection from the relevant anatomy departments. Each HOS or HOD of Anatomy at the identified health science faculties gave permission for the gross anatomy course coordinators to be contacted. Participation in the study was vol- untary, anonymous and no incentives were offered to participants.

4.2.1.4 **Survey structure and outcome variables**

The survey for this study was adapted from an existing open access IRB approved instrument used to measure how PT schools in the United States teach gross anatomy (Reimer et al., 2013). It was not a standardized instrument and was merely used as a guideline for this study as it was designed to collect data on the specific topic of gross anatomy education for undergraduate PT students and it was the most recent survey on the subject. The Reimer et al. (2013) survey questions were either altered extensively to suit the South African gross anatomy health sciences educational system both in content and in terminology, were omitted as they addressed matters not relevant to the research ambit of this study or were omitted because the answers could lead to identification of respondents due to the survey sample being small and very specific. Some new questions were also added to the South African survey. This survey was designed to collect mainly quantitative descriptive data and was divided into eight sections. These sections pertained to enquiry on matters such as staff demographics and student numbers as well as hours spent in anatomy and how that time was distributed between lectures and practical sessions, use of dissection, prosection, computers, plastinated

specimens, surface/living anatomy, and the types of learning programmes available in that faculty. In some questions application of the “other” category facilitated a drop down answer box, through bridging logic, whereby the respondent could add an alternative answer to the offered options. This category, in some instances resulted in the respondent writing a short descriptive comment on the reasons for their answer. No specific qualitative research methodology was applied to collect or analyze these data. However, a few of the comments are presented in the text, in the form of quotes, as an adjunct to the quantitative results.

In order to assess internal reliability of this survey, questions were grouped thematically into main categories: time spent in anatomy, pedagogies, learning programmes, materials used to teach anatomy. Each question in a group was considered to be ordinal. For each construct internal reliability was established by calculating Cronbach’s *a*. Questions pertaining to staff demographics, student information, type of curriculum, and course assessment could not be subjected to this statistical analysis due to the type of data collected or the presence of insufficient data for analysis.

Nonparametric correlations were made using Kendall’s tau B. However, the statistical test could only be applied to four questions in two groupings. This was due to small sample size and the fact that most constructs did not fall into groups that could be statistically correlated with others. The survey was also peer-reviewed prior to circulation to study participants. Content was reviewed by two senior anatomists and by the 2015 gross anatomy course coordinator for undergraduate PT students at WITS. Minor content adjustment was implemented and increased user-friendliness as an online survey was established. The 2015 WITS PT gross anatomy coordinator did not take part in the 2016 survey.

The electronic gross anatomy survey was sent out to the nine eligible recipients from the eight universities on 11 March 2016. An online platform, namely REDCap (Research Electronic Data Capture, Johannesburg, South Africa) hosted at WITS, was used to distribute the questionnaire to participants (Harris et al., 2009). Participants had six week to respond to the survey. Three reminders were sent to potential study participants.

4.2.1.5 **Data Analysis**

Descriptive data analysis was done using IBM SPSS 24 statistical package, version 24.0 (IBM Corp., Armonk, NY). A statistical calculation of Cronbach’s *a* was used on relevant

ordinal data to test for internal reliability within the questionnaire and those results are presented in the text. A Kendall's tau B statistical test was performed on the questions that had calculable correlations. The results are presented in the text. Findings are presented as means (standard deviation), medians and ranges by the use of tables. Interdisciplinary student group participation in gross anatomy laboratory sessions is presented in Figure 4.1. Missing data were not replaced and therefore not included in the analysis process.

4.2.1.6 **Results**

Out of the nine gross anatomy course coordinators approached to participate seven (77.8%), from six of the eight universities (75%), responded to the study invitation. Results from the two coordinators from the same university have been pooled to give a comprehensive overall result for that health science faculty.

The Cronbach's *a* internal reliability for the four measured thematic groups were 0.750, 0.792, 0.820, and 0.892 for the following constructs: materials used to teach anatomy, time spent in anatomy, pedagogies, and learning programmes, respectively. These results show a Cronbach's *a* internal reliability range from acceptable to good for the constructs. The Kendall's tau B correlations were between: total number of staff and student numbers with a moderate to strong insignificant positive correlation of r 5 0.68 (P < 0.098) suggesting that an increase in student numbers might correspond to an increase in staff members and a very strong insignificant negative correlation of r 5 20.91 (P < 0.071) between the number of students per cadaver to the number of cadavers available suggesting that an increase in cadavers might lead to a decrease in the number of students per cadaver. Validity of the entire questionnaire was not possible due to the fact that the relationship between questions in the main was not conducive to correlation statistical analysis, instances of missing data reduced data available for analysis and/or the small sample size influenced statistical reliability.

4.2.1.7 **Staff profile**

Table 4.1 summarizes results relating to the demographic profile of teaching staff for average number of staff per faculty (7.8 ±4.7), average years of staff experience (8.6 ±3.3) and average male and female staff numbers. The male to female staff ratio averaged 1:2 across faculties. In 83.3% of the faculties studied there was over six staff members. Reported academic staff experience was of two distinct categories. Staff level of education included members with doctoral (Ph.D.), masters, honours, and bachelor's

degrees. No staff compliment had the same combination of higher qualifications as another.

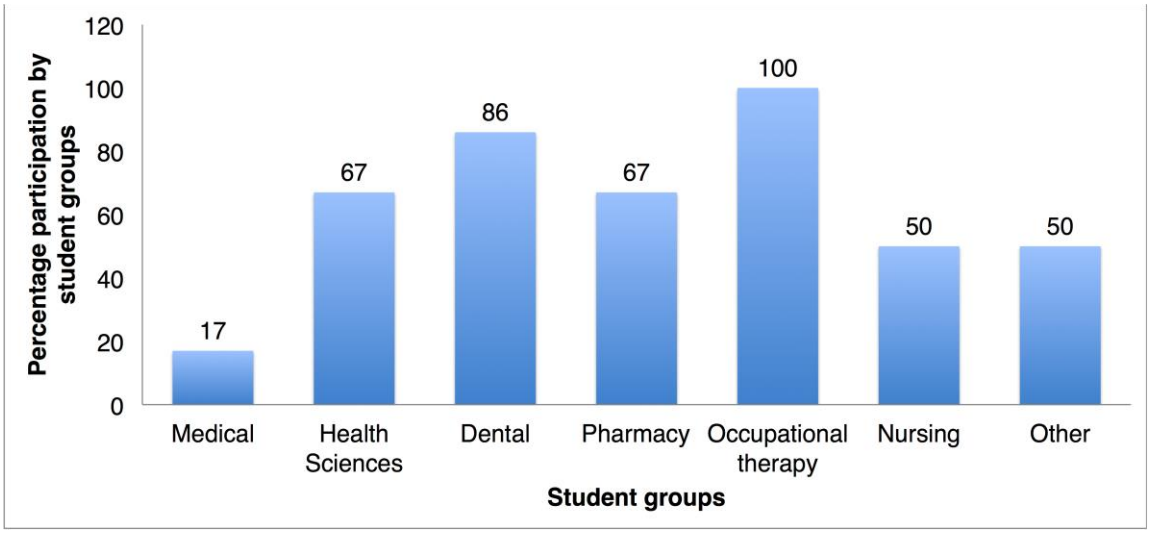

Figure 4.1: Student Groups from Healthcare Disciplines that Share the Gross Anatomy Laboratory with Physiotherapy Students.

4.2.1.8 **Number of students and staff to student ratio**

The average number of PT students in each South African faculty is 60.5 (SD ±12.6). All faculties reported that ten or fewer students were repeating the course for a second time. Staff to student ratios fell into two categories of under 1:10 (1:3, 1:5, and 1:8) and over 1:30 (1:30, 1:35, and 1:39).

Table 4.1: Staff Profile in Health Sciences Faculties in South Africa

Staff demographics	Faculty respondents	Range	Mean (±SD)	Median
Total staff [a]	6	0-15	7.8 (±4.7)	8.0
Staff experience (years)	5	5-11	8.6 (±3.3)	11.0
Male	6	1-6	2.0 (±2.1)	1.5
Female	6	1-11	4.0 (±3.9)	2.5

a Including: Lecturers, teaching assistants and tutors

4.2.1.9 **Time Spent in Teaching the Gross Anatomy Course**

Table 4.2 summarizes results pertaining to the number of gross anatomy semesters in a course (2.3 ±1.3), total number of weeks spent in anatomy (27.6 ±5.7) and the number of hours spent in gross anatomy (207.6 ±78.1). This table also records the direct contact hours per week spent by PT students in lectures and practical sessions as well as the allocation of “open laboratory” time (4.8 ±1.1). The total number of calculable hours spent in gross anatomy across five faculties was recorded as 100, 182, 196, 252 to 308 (207.6 ± 78.1). Due to missing data, the total hours for the sixth faculty could not be calculated. The direct contact hours per week, that students experienced either in lectures or in the dissection laboratory (practical work), were seen to vary across the country. Half of the programmes offered approximately seven direct contact hours per week but the other three programmes did not conform to this pattern. The total gross anatomy learning time, including direct contact hours, for a programme could also incorporate time spent in computer based learning, open laboratory time, and other forms of time utilization.

4.2.1.10 **Laboratory Information**

Cadavers available for dissection ranged between zero and twenty-one with a mean of 6.43 (SD ±7.30). One faculty had no whole body cadavers and only offered the students cadaveric sections. The number of students per cadaver varied with a mean of 8.0 (SD ±3.5) and ranged equally between 4–6 students and 10–12 in two faculties respectively. Healthcare student groups sharing the gross anatomy laboratory with the PT students across faculties are shown in Figure 4.1.

4.2.1.11 **Teaching Pedagogies**

A number of faculties included the same pedagogical combination of: dissection, prosection and anatomical models/ plastinated specimens with a mean of 1.67(SD ±1.16).

A respondent commenting on the use of computers said “it gives the students the opportunity to look at structures in 3D” and another said “it was the ability to view the body in a similar manner as if dissecting it.” Three of the six faculties did not have a computer based learning programme. In this regard a respondent commented that ‘there are not enough computers available in the faculty for all the students to use at once’ and another ‘the university unfortunately have not approved the budget to buy computer based programme for students to use.’ The types of computer programme used in two of

the other three faculties included Acklands and Real Anatomy. Computer programmes had been in situ for at least five years in faculties that had computers.

Reasons given for the use of anatomical models or plastinated specimens was “due to a shortage of cadaveric material” or because “large models were helpful to show small structures like the eye” “or could be used to show structures not easily seen on a cadaver.” The number of anatomical models and/or plastinated specimens found in five of the faculties ranged from 25 to 40 with a mean of 34 (SD 68.2). A wide range of anatomical models and plastinated specimens were available as shown in Figure 4.2. In the “Other” category it was noted by respondents that there were few anatomical models/plastinated specimens of the perineum and that the larynx needed to be included on the list. Although the survey questions were on the use of plastinated specimens it appears that some answers pertained to (plastic) anatomical models instead.

Table 4.2: Total Time Spent on Gross Anatomy Programmes and Distribution of Time Spent in Theoretical and Practical Aspects of These Programmes

Variable	Faculty respondents (N)	Range	Mean (SD)	Median
Semesters in gross anatomy programmes (N)	4	2-4	2.3 (±1.3)	2.0
Weeks in anatomy programmes (N)	5	20-36	27.6 (±55.7)	28.0
Total anatomy (hours	5	100-306	207.6 (±78.1)	196.0
Direct contact in lectures (hours)	6	1.5-6.	3.9 (±1.6)	3.5
Direct contact in practical sessions (hours)	6	1.5-5.5	3.5 (±1.8)	3.5
“Open laboratory” time (hours)	4	1.5-6	4.8 (±1.1)	5.75

Living/surface anatomy sessions were found in the majority of faculties. Ways of conducting surface anatomy described by respondents were: “I normally ask students to palpate on themselves when it is possible” and “we also require them to palpate on the cadavers prior to removal of the skin for dissection.” Where this teaching methodology was not available it was due to “differences in students’ cultural and religious beliefs” or because the class was very big and such a lesson would “consume quite some time.

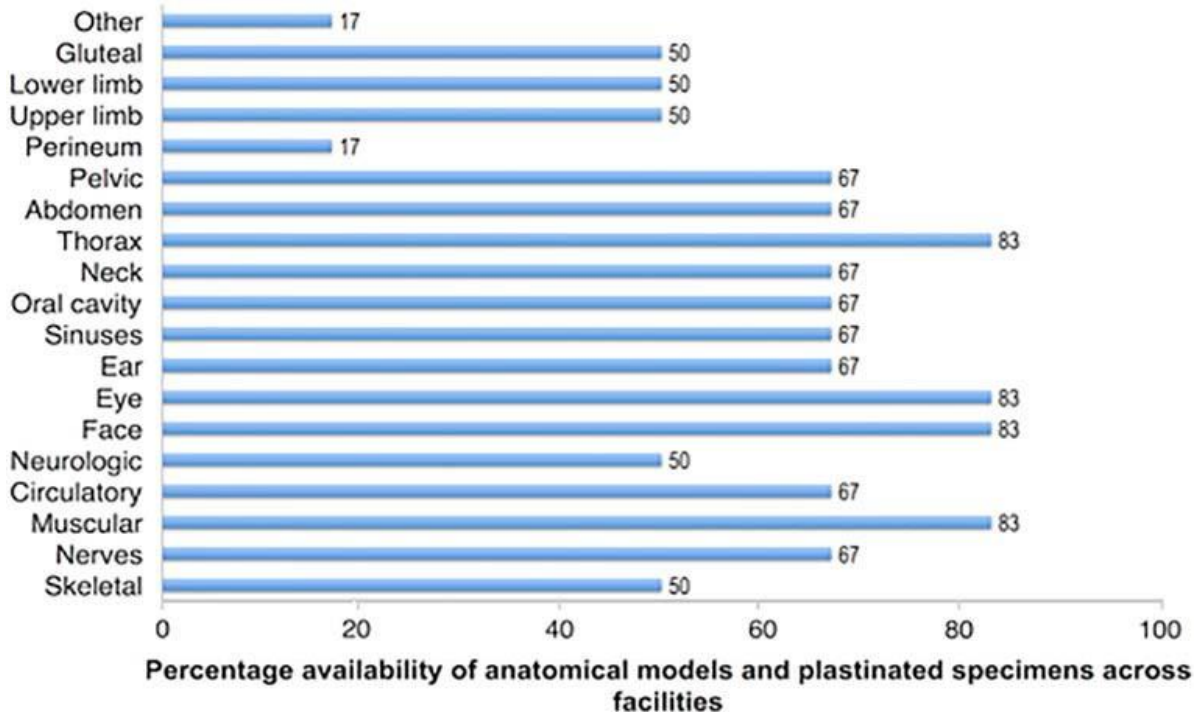

Figure 4.2: Distribution of Anatomical Models and Plastinated Specimens by System or Region Across Surveyed Faculties

4.2.1.12 **Approaches to Learning and Assessment**

The approach to learning gross anatomy included: regional anatomy in half of the programs, systemic anatomy in one programme and mixed methods in two programmes. There was a varied distribution of learning programmes among the faculties. The choices that were given are summarized in Table 4.3 together with the various combinations of learning programs found. Three faculties used online learning management systems. Only one named the programme used (Moodle). All programmes used multiple-choice questions (MCQs), short essay questions and timed spot tests. One faculty also gave the students one long essay question per test/examination and three programmes held viva voce examinations. With regards to teaching evaluation of staff by PT students' one faculty did not have a process in place, two faculties had an online Quality Performance Accreditation (QPA) questionnaire and two faculties used student evaluation forms. Another respondent remarked that questionnaires were used. To the question: Is there an on-going gross anatomy program review process in your faculty? Four respondents replied yes, one was unsure and one said no.

Table 4.3: A Summary of the Distribution of Learning Programmes across South African Health Science Faculties

Types of learning programmes offered in the faculties	Health Sciences faculty respondent	Combinations of learning programs used in the faculties
A. Didactic learning	1	A, B, C, D, E, F, G, H, I, J
B. Problem-based learning (PBL)	2	A, B, F, H, I, J
C. Vertical integration	3	A, B, H, K
D. Integrated teaching	4	A, B, C, E, F, G, H, I
E. Inter-professional education (IPE)	5	D, F, G, H, J
F. Peer group teaching	6	A, B, H
G. Peer group tutoring		
H. Tutoring by lecturers or teaching assistants (TA'a)		
I. Team-based learning (TBL)		
J. Case-based learning (CBL)		
K. E-book learning		

4.2.1.13 **Discussion**

This study gathered much useful information about gross anatomy staff demographics, teaching methods and resources available as they pertain to gross anatomy education programmes for undergraduate PT students at health sciences faculties in South Africa. It highlighted areas of disparity between the gross anatomy programmes offered nationally.

Teaching staff to student ratios in gross anatomy programmes were obtained in order to compare them to similar international data and to establish whether international trends towards a decrease in staff to student ratios applied in the South African context. In their narrative review, Bergman et al. (2011) reported that Pryde and Black (2005) had found that staff to medical student ratios in Scotland had decreased from 1:20 in 1983/1984 to 1:58 in 2003/2004.

It was stated by Kramer et al. (2008) that suitable staff to medical student ratios across the African continent were high (between 1:15 and 1:35 in Egypt, 1:15 to over 1:35 in Nigeria, Uganda, and South Africa, 1:25 in Malawi and Mozambique and 1:30 in Zambia). A 2012 survey in Saudi Arabia found that medical students did not feel that a

ratio of staff to students of 1:21 was conducive to work in a team during anatomy sessions (Kemeir, 2012). In Tanzania, a 2016 study of medical student anatomy education recommended the use of reciprocal peer teaching to address what the authors considered a poor staff to student ratio of 1:38 (Manyama et al., 2016). The ratios recorded in this study fall evenly on either side of the Australian and Saudi Arabian benchmarks and in comparison to the Tanzanian study only one of the South African faculties reported a poorer staff to student ratio. A recent study by Green and Whitburn (2016) in Australia has thrown new light on this matter by reporting staff to PT student ratios during anatomy practical sessions of approximately 1:25. No definitive reference in the literature to an optimum staff to student ratio for PT anatomy education was found. However, using the available literature for direction it would appear that it would be best if the ratio were at least within the 1:20 to 1:30 range. In this study, the mean ratio for all six faculties was 1:20 and the median was 19 that fell well within these parameters. However, the distribution of the results fell into two distinct categories where a half of the faculties reported ratios below this range and half were equal to or above this range. So the overall picture appears misleading when compared to the nationwide distribution of the results.

This survey showed that the staff teaching the anatomy course generally had doctorate, masters, honors or bachelor degrees. This breakdown of personnel by level of education teaching anatomy to South African PT students mirrors the results reported by Kramer et al. (2008). In this study staff experience averaged 8.6 (63.3) with the majority having more than eleven years of experience. Similarly Reimer et al. (2013) also found the majority of staff teaching PT students' gross anatomy in faculties in the United States had more than eleven years of experience. The ratio of male to female staff members reported was indicative of a tendency for twice as many females than males to be in this line of work. This ratio could not be compared to international data as none were reported in the available literature.

Four of the six respondents (67%) reported that their gross anatomy programmes offered dissection to the students. In this regard, Heylings (2002) found that in the United Kingdom and Ireland dissection was still being used in 76% of anatomy programmes for medical students. Kerby et al. (2011) in the United Kingdom and Bekele et al. (2011) reported that undergraduate medical students in Germany and Ethiopia viewed dissection to be a relevant part of their course. Perhaps this attests to the findings of Patel and Moxham (2008) and Torres et al. (2014) who found that dissection was the

preferred gross anatomy teaching methodology and Reimer et al. (2013) who reported that 92.6% of the respondents to their survey used dissection in their faculty. It is important that gross anatomy teaching methods help with the retention of the core content into clinical practice. In this regard, Hasan et al. (2010) argued that the move away from traditional cadaveric dissection was not wise and that human dissection was the best way of establishing the core knowledge necessary for good anatomical knowledge retention and similarly Khan et al. (2015) after surveying Pakistani physiotherapists and PT students found that dissection was regarded as beneficial to the understanding and retention of anatomy. The mental three-dimensional (3D) imaging associated with dissection was also linked to beneficial retention outcomes (Marks, 2000; Granger, 2004).

This study found that, at the majority of the South African universities surveyed, human dissection had been anatomy pedagogy from the inception of the PT programmes to date. Based on the literary findings this may augur well for the continuing retention of anatomical knowledge in these students.

Furthermore, PT is a “hands on” profession. The palpation of tissues, the depth of structures with related 3D appreciation of anatomical relationships and the accurate location of such structures are pivotal to beneficial treatment of patients. In this regard it has been noted by some authors that human dissection is incomparable for the type of anatomical education that acknowledges the importance of “the feel of human flesh” (Azer and Eizenberg, 2007; Bo€ckers et al., 2010; Hasan et al., 2010; Sugand et al., 2010).

There was no shortage of cadavers for dissection at four of the faculties surveyed and this was reflected in the student to cadaver ratios. Gangata et al. (2010) reported that 80% of cadavers used for dissection in South Africa were donated. They also stated that in many African countries the lack of awareness of the possibility of donating one’s body together with religious and cultural burial traditions resulted in a low number of cadavers being bequeathed. The shortage of cadaveric material in certain South African regions may perhaps be explained by this phenomenon and be related to the fact that two of the surveyed programmes reported a high ratio of 10–12 students per cadaver and one linked the use of plastinated specimens to such a shortage.

The progressive time constraints in anatomical teaching hours have been described (Drake et al., 2009, 2014). Drake et al. (2009) reported the average national hours spent teaching anatomy courses in the United States in 2009 was 149 hours. The national average calculated using this survey stood at 207.6 (SD 678.1) hours. However, in a longitudinal cohort study conducted in the United States between 2010 and 2015 it was found that the level of medical students' retention of anatomy increased over the first two years of their medical degree and remained at a 90% level over the final two years even when the gross anatomy component was reduced to approximately 60 hours (McBride and Drake, 2016). Recently, Pawlina and Drake (2017) reported that the fundamental content of an anatomy course for medical students has not changed over the years but students are expected to learn it in a shorter time frame. In this regard, an average of 76% of third, fourth and fifth year students in Saudi Arabia identified anatomy as having too much content for the available course time and the author identified this factor as one that contributed to increasingly negative opinion of basic sciences like anatomy by such medical students (Alam, 2011). However, contrarily McBride and Drake (2016) found the decrease in time had not impacted adversely on medical students' understanding and retention of fundamental anatomical concepts. These opposing views may be explained by the fact that issues such as the structure of the curriculum and pedagogy used to teach it might be influential in dealing with the time constraints more effectively in certain faculties. Interestingly five of the six surveyed South African faculties spend more time in gross anatomy teaching than the amount of time allocated to it in the United States eight years ago and this may be due to the fact that dissection, that is time consuming, is still prioritized. Noticeably, the implementation of a substantially shortened gross anatomy course that delivers beneficial outcomes as suggested by McBride and Drake (2016) is not being utilized in South Africa at the moment although one faculty did report that their gross anatomy course consisted of only 100 hours of instruction and they used prosection.

It has been argued that the observation of prosected material may be more feasible especially where dissection to reach deep structures such as the heart and lungs, by regional approach, may take a great deal of time (Leung et al., 2006). Time may be saved as many student cohorts can use the prosected cadavers for observation especially in places where there are few cadavers available (Pather, 2015). These factors coupled with the decrease in anatomy hours also means that long dissections cannot be undertaken and so students cannot spend a great deal of time in pursuit of exposing structures (Dinsmore et al., 1999). Craig et al. (2010) found, in a survey of

anatomy education in twenty- one medical schools in Australia and New Zealand, that only three medical schools offered dissection as a whole body experience. These authors reported that prosection was used predominantly for gross anatomy education. However, the choice of prosection is that instance was not due to a decrease in cadaver donations. This study's findings indicate prosection is not the most favored gross anatomy pedagogy for teaching gross anatomy to PT students in South African health science faculties. This could be due to high total gross anatomy hours being available and the fact that cadavers are not in short supply leading to a preponderance of dissection over prosection.

Descriptions of gross anatomy pedagogical interventions involving different and diverse groups of students in the laboratory setting have been reported in the literature namely: medical and PT students involved in teamwork and clinical problem solving in association with dissection (Sytsma et al., 2015), medical and DPT students using quick response codes on cadaveric specimens (Traser et al., 2015), and medical, midwifery, nursing, physicians assistant, PT, and occupational therapy students dissecting in inter-professional groups (Fernandes et al., 2015). Hence, in line with international trends, inter-professional student interaction occurs during laboratory gross anatomy programmes in this country but in only two faculties formal inter-professional education was implemented. Peer group teaching was found in four of the six surveyed faculties. It is not clear whether this occurred solely within PT groups or in an interdisciplinary fashion. The literature gives successful examples of peer teaching both in the inter-professional scenario and within DPT peer groups (Youdas et al., 2008; Wait et al., 2009; de Oliveira et al., 2015).

All surveyed universities are located within urban areas of South Africa. Some have not been established for as long as others and/or are not as financially equipped. The resultant problem with budgetary constraints led two respondents to point out that their faculties did not use computer-based learning. A respondent felt that computer technology gave the student a 3D perspective of anatomical structures. This is on a par with the feedback given by Sil'en et al. (2008) regarding the learning of such complex structures. Lewis et al. (2014) also stated that the use of tablet computers, with certain anatomy applications, not only give the student a 3D perspective of structures but allows the student to manipulate such structures. Biasutto et al. (2006), in a comparison of cadaver dissection to computer-based learning, concluded that neither methodology in isolation was the optimal choice and that a combination of the two pedagogies offers the

best option. However, they pointed out that computer technology does not replace the “hands on” value of interacting with human tissues that comes with dissection. This point reiterates the previously quoted opinions of a number of authors (Azer and Eizenberg, 2007; Boeckers et al., 2010; Hasan et al., 2010; Sugand et al., 2010).

Lectures are still in use in South African anatomy teaching for the PT student population. In fact the average time spent in lectures is 4.3 (SD 6.17). This is high if compared to the time spent in lectures reported by Green and Whitburn (2016). The fact that the lecture model is often seen as old fashioned and too passive (Pawlina and Lachman, 2004) may predispose to this more mixed methods “blended” approach to the learning of anatomy particularly with the use of computer technology (Graham, 2006; Estai and Bunt, 2016). However, beneficial learning outcomes from this type of methodology may require the maintenance of personal interaction in practical sessions and rely on students and staff dealing with a perceived increased workload (Green and Whitburn, 2016). It appears that a computer and lecture blended approach is in place in half of the South African institutions. Practical sessions are being held in conjunction with this where students and staff interact as per the recommendations of Green and Whitburn (2016). However, the choice of a blended learning approach is not an option in the other 50% of the faculties surveyed due to the reported lack of computers and this is a barrier to them moving forward using current trends in gross anatomy teaching.

Azu et al. (2012) reported that 75% of surveyed medical and anatomy students found plastinated specimens to be an extremely useful tool for anatomy learning. They can be used where cadaveric material is in short supply as a respondent pointed out. On the other hand, Craig et al. (2010) reported that plastinated specimens were used by less than half of the programmes identified in the Australian and New Zealand study. Time constraints that have arisen in gross anatomy education, as reported by Papa and Vaccarezza (2013), have also been given for the increased use of such resources. This study found that they could be used in place of cadaveric material and for the clearer orientation, recognition, and learning of small structures or those that are difficult to see with dissection.

In the case of living anatomy peer physical examination students physically examine each other and body painting can be used (Rees et al., 2005; Estai and Bunt, 2016). In body painting, marker pens and wax crayons are used to paint the position of internal anatomical structures on the surface of the skin (McMenamin, 2008; Estai and Bunt,

2016). In a study involving undergraduate PT students, colored non-toxic paints were used to carry out body painting (Nanjundaiah and Chowdapurkar, 2012). Body painting can also be used in combination with other modalities as seen in a multi modal study (Nicholson et al., 2016) Medical students found a body painting experience to be enjoyable but they also felt that it helped them remember anatomical knowledge (Finn and McLachlan, 2010; Estai and Bunt, 2016). In a unique study carried out by Gangata (2008) in Cape Town, South Africa an intervention termed the “cut out and paste” exercise was tested on a cohort of undergraduate PT students together with an undergraduate group of occupa- tional therapy students. It involved the students cutting out and pasting the correct muscle over the relevant area on a skeleton. Not unlike the body painting exercise described by Finn and McLachlan (2010) for medical students the allied health science students found the experience of a “cut out and paste” exercise fun and enjoyable and useful in the learning of gross spatial anatomy. Despite much positive feedback regarding the use of the afore-mentioned living/surface anatomy modalities certain limitations on their use have been encountered due to gender, area of body to be used and religious concerns (Rees, 2007; Reid et al., 2012). In this regard, most programmes surveyed offered some form of surface/living anatomy practical sessions. However, limitations were given to the conduction of these sessions and ranged from religious or cultural concerns to large class structure and resultant time constraints to conduct this form of classwork. Suggestions made by respondents for their students to participate in living/surface anatomy sessions included the palpation of structures either on the skin of a cadaver, on a willing class volunteer or on themselves. Body painting has been described as a useful modality to facilitate the learning of surface anatomy when the classes are large (Op Den Akker, 2002; Estai and Bunt, 2016). Therefore, this is perhaps a modality that could be incorporated into the teaching curriculum in South Africa to address issues like better time management in living anatomy where there are large classes. Similarly, “muscle cut out and paste exercises,” as described by Gangata (2008), could be considered for inclusion to improve learning outcomes in an interesting and enjoyable way and help address some of the afore-mentioned limitations. Furthermore, Nicholson et al. (2016)’s successful incorporation of four multi-modal learning strategies into an anatomy workshop for health sciences students could be applied to the South African programmes and offer beneficial outcomes.

Globally, students learn gross anatomy by a systems-based, regional-based or a mixed approach incorporating both of the other two methods. Stabile (2015) reports that the systemic approach may not be best suited to use with dissection and may be problematic

for precise identification of structures and the interrelationship between them. She recommends that the mixed approach is probably preferable. The findings from this study show that all these approaches are used to different degrees in the South African setting.

Case-based learning with vertical integration seeks to help address the need for a link between anatomy and future professional practice (Parmar and Rathinam, 2011). This study found only one programme followed this process. Some studies had one or more of the other programmes discussed. In particular peer group teaching has had beneficial results on student examination outcomes in inter-professional groups as reported by de Oliveira et al. (2015) in Brazil. Integrated human anatomy learning using web-based methodology for small groups of PT and occupational therapy students was shown to be beneficial for the memorisation of anatomy structures and the interrelationships between such structures (Thomas et al., 2011). Respondents reported that integrated teaching occurs in two of the South African faculties surveyed. However, in one of these faculties computers are not available to students so it is not feasible that integrated learning can be followed in that faculty. With regard to integrated learning approaches a study in Canada revised the anatomy curriculum but still maintained the basic problem based learning (PBL) format using small tutorial group teaching. However, they focused on conceptualization and the use of repetition of examples to reinforce the learning of concepts (Neville and Norman, 2010). McBride and Drake (2016) also used repetition of anatomy concepts as part of their study with beneficial outcomes. Neville and Norman (2010) further reported that the changes in the curriculum had led to a change in the way in which the tutorial material was written and delivered to the students and that web-based resources had been integrated into the curriculum and this improved learning within small groups of students (Neville and Norman, 2010). Five of the surveyed faculties reported using PBL but of these only two also used TBL and had computers. Hence, only two could give consideration to utilizing the teaching methodology outlined by Neville and Norman (2010).

This survey identified that most evaluation of the effectiveness of gross anatomy programmes was done by examinations that followed the same basic format with only one faculty including the use of a longer essay question in each of their examinations. In this regard, Zhang et al. (2013) reported that, for entry-level DPT students, the comparison of the results of timed and untimed practical spot tests showed no significant difference. In South Africa spot tests are administered using the timed format. Fabrizio (2013) has suggested that oral laboratory examinations for PT students utilize time more

effectively especially by eliminating wasted time during setting up of the examination, do not bar students from laboratory access for days while preparation is undertaken and allow for questions to be more complex in nature than those used in the spot test scenario. In this regard, half of the South African faculties use viva voce examinations in combination with spot tests for student assessment and not as a replacement for the latter as suggested by Fabrizio (2013).

A gross anatomy course curriculum has to be developed to accommodate the ever-increasing volume of content with a decreasing time frame for delivery of that content (Mitchell and Batty, 2009). New aspects of curricular change for anatomical programmes have been investigated (Drake et al., 2014). With regards to the previous point the different types of PT degree programmes offered worldwide are designed to accommodate the needs that pertain to the specific PT practice in each of those countries. This means that anatomy curricular design for a PT student population has to be appropriate for the needs of the clinical PT practitioner as per the requirements of the controlling allied medical board in that country and the relevant needs of the patients in that country (WCPT, 2015). As pointed out by Drake et al. (2014), the requirements of the student body to be taught by a particular institution has to be factored in when a curriculum for an anatomy programme is being considered. The final product of a professional and clinically orientated practitioner with the necessary anatomical skills is what the early anatomical education should envisage (Swick, 2006; Pawlina, 2006; Moxham et al., 2014).

4.2.1.14 **Limitations and future directions of the study**

A future study of this nature should look at the breakdown of the staff teaching gross anatomy into academic (lecturers) and clinical (physiotherapists) categories to analyze the effectiveness of having direct input from both of these professions in making the course more clinically orientated. Studies should be engaged to assess undergraduate PT students' academic outcomes and the faculty throughput should also be recorded to assess the effectiveness of any gross anatomy programme.

4.2.1.15 **Conclusions**

This study gives an up-to-date report on aspects of gross anatomy programmes for undergraduate PT students in South Africa. It establishes a baseline from which future research can be launched.

The evidence suggests that allied health science students should learn gross anatomy using dissection, prosection, and plastinated specimens. Furthermore, a mixed pedagogical approach may be the best overall learning solution. However, this study found dissection as preferred pedagogy. Prosection was also used to a lesser degree. Both of these pedagogies occurred in conjunction with other mixed methods including the use of plastinated specimens. This use of mixed methods is in line with literary suggestions for beneficial learning.

There is wide diversity in the way gross anatomy is taught in the six health science faculties in South Africa that took part in the survey. South Africa has no national guidelines and no conformity in programmes and this may impact on quality outcomes being achieved. Hence, specific guidelines are needed for the development of unified, country specific gross anatomy programmes for undergraduate PT students. It is encouraging that six out of the eight health science faculties took part in this survey a fact that may lead to more cooperation and uniformity in such programmes in the future.

Overall, the survey results contribute to the body of knowledge on gross anatomy education globally.

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This study adds a South African perspective to the overall outcome of the thesis was by identifying plausible, beneficial and implementable curricular and pedagogical suggestions that can be presented to relevant tertiary and governmental bodies in order to help facilitate a unified national gross anatomy educational programme for undergraduate PT students in South Africa.

LINKING NOTES BETWEEN APPENDIX 1 AND CHAPTERS 3 AND 4 (PAPERS 1, 2 AND 3)

This section contains information to clarify the link between Appendix 1 and Chapters 3 and 4 (Papers 1,2, and 3). An in depth discussion of the findings of each individual paper is presented in the discussion sections of the papers. An overall discussion of the thesis can be found in Chapter 7.

Paper 1 informed the basis for the collection of data pertaining to the global perspective of gross anatomy education for undergraduate PT students. The initial review of the literature in the protocol document produced a sound grounding for the systematic collection of data that was carried forward into Paper 2 namely, a scoping review on the same topic. The protocol document methodology also provided evidence that there was sufficient literary information to warrant the conduction of the scoping review.

During the study for Paper 2 the first thorough systematic search of the available literature, in 2016, uncovered information that gave direction to the design of the national gross anatomy survey conducted in Paper 3. Subsequent database searches together with perusal of reference lists during 2017 and finally 2018 resulted in a comprehensive picture of the global state of gross anatomy education for undergraduate PT students. After the findings of the national gross anatomy survey (Paper 3) were analysed they could be compared to those found in the global scenario. This created an opportunity to evaluate the way in which gross anatomy education was conducted for the PT student body in South Africa. It also identified different and interesting methods of teaching that could be considered for implementation in South Africa. The charting template designed for the protocol document (Paper 1) was used for the initial detailed summarising of the scoping review papers but the final reporting of the findings was as per the JBI author guidelines.

Overall the studies in these chapters provided insight into global and national gross anatomy programmes for PT students. They raised factors essential for consideration in the formulation of a unified gross anatomy curriculum and pedagogy for South African PT students.

CHAPTER 5

5.1 STUDY 3

Title: Opinions of Physiotherapy Practitioners in the Service Delivery Sectors in South Africa with regard to Gross Anatomy Education for Undergraduate Physiotherapy Students

5.1.1 Introduction

As has been highlighted in Section 2 of Chapter 2 (narrative literature review) of this thesis physiotherapists in South Africa are first line practitioners and as such are autonomous (Freidson, 1970 cited in Sandstrom, 2007), practice independently (WCPT, 2011) and have to have a suitable level of gross anatomy knowledge to equip them for the demands of their particular professional clinical practice. These practitioners are also aware of the different specialisations in the PT profession and the unique requirements needed to prepare students for possible participation in such specialities in their future careers. It would therefore be remiss in an evaluation of what undergraduate PT students need to cover in their anatomical education to not include some input from physiotherapists in the public, private and academic sector in this country. Therefore, as part of this research it was deemed necessary to collect this information and it was decided that the best way to do this would be the use of FG discussions and to utilise a qualitative post positivism grounded theory approach (Creswell and Poth, 2018). The inclusion of qualitative research in this thesis also adds a different dimension to it and strengthens the overall research methodology. The information gleaned in this way can be collated with that already gathered during the scoping review in Study 1 (Paper 2, Chapter 3) and the national perspective in Study 2 (Paper 3, Chapter 4) in order to start to build and plan the way forward to arrive at possible new suggestions for gross anatomy curricular changes for this student body.

5.1.2 Aim and Objectives

The aims and objectives of this study have been included in points 1.4 and 1.5 of Chapter 1 respectively.

5.1.3 Methodology

Grounded theory research intends to progress beyond description in order to create or find a theory (Corbin and Strauss, 2007).

5.1.4 Study Design

A qualitative study using FGs was undertaken using a grounded theory approach. Grounded theory is defined as an emergent method and as such it is open-ended, has no determinate format and involves a process of induction (Charmaz, 2008). In grounded theory data collection and analysis are carried out simultaneously in order to allow a continually changing response to theoretical sampling (Corbin and Strauss, 1990). The grounded theory approach demands a very specific methodology for the gathering and analysis of data (Charmaz, 2014; Lempert, 2007; Corbin and Strauss, 2007, 1990). The analysis of data followed an inductive methodology to establish patterns or themes (Cresswell and Poth, 2018). Certain factors necessary for reliability and strength of this qualitative research were implemented.

5.1.5 Sample Size and Selection

The opportunity to participate in this study was open to all physiotherapists who are employed in a PT service delivery sector, as listed in Figure 5.1, in the Gauteng Province of South Africa. This province has a large number of physiotherapists many of whom have come from the other provinces and is therefore representative of PT practitioners in this country. Due to the fact that a grounded theory approach was utilised in this study the sample size was dependent on the number of eligible participants to be sampled in order to reach theoretical saturation. It was a non-probability sample (Smith, 2000) with participants being chosen by theoretical sampling (Cresswell and Poth, 2018; Mays and Pope, 1995).

All participants within each sector had an interest in a specific area or more than one specific area of PT practice i.e. adult neurology, cardiopulmonary, community health neuromuscular-skeletal, orthopaedics, and paediatrics. The input within the FG process may therefore have resulted in a skewed perspective from theoretical sampling if this fact was not taken into consideration.

Before sampling began participants were required to furnish information as to their specific area of interest in PT. Sbaraini et al. (2011) reported on the use of a purposive sampling strategy in order to provide maximum variation in data collection. There may be an element of purposive sampling strategy that was used in this study to maximally utilise the FG process in order to produce a balanced pool of PT input and so produce a relevant substantive theory.

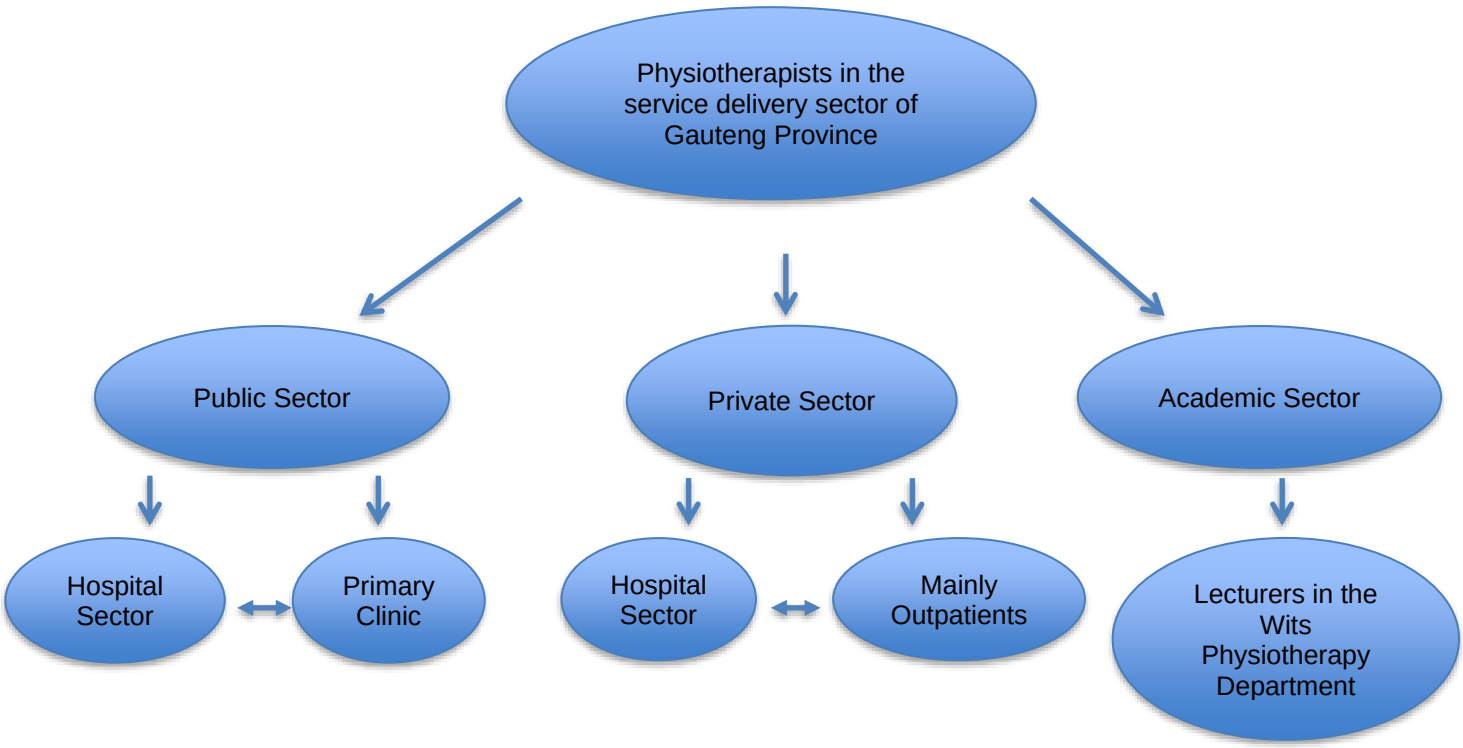

Figure 5.1 Physiotherapy Sectors for Focus Group Study

5.1.6 Inclusion Criteria

Physiotherapy lecturers, who teach undergraduate PT students in the WITS PT department, PTs in public hospital and/or primary clinic facilities and PTs in private hospital and/or out-patient practices in the Gauteng Province of South Africa.

5.1.7 Exclusion Criteria

No exclusion data are noted for any of the eligible participants.

5.1.8 Tools and Outcome Measures

All FG discussions including the pilot study were recorded using an Olympus digital voice recorder (VN-733PC). A demographic questionnaire (Appendix 14) was sent electronically or handed to possible participants together with the information sheet (Appendix 8). An informed consent document (Appendix 7) for permission to record participant's input was sent or handed to participants with the other documentation and was completed by all participants prior to their specific FG discussion. The pilot FG discussion (FG1) was conducted using a semi-structured, open-ended questionnaire (Appendix 15). Thereafter the questions were modified according to the results of field note perusal and a reflective process of personal memo writing carried out by this researcher after each FG session.

5.1.9 Procedure

The procedure followed to collect data was driven by the principles of grounded theory. With this in mind the collection of the data was not based on any preconceived hypotheses and the principal of using a constant comparative analysis as information was collected was used (Portney and Watkins, 2009). The on going data analysis process led to the adaptation of questions for subsequent focus groups in order to further facilitate the collection of data with the intention of reaching theoretical saturation. The concept of theoretical saturation, as coined by Glaser and Strauss (1967), is only achieved if/when no more information is being offered by a FG on a particular topic. The FG process was continued until the data collected was saturated.

The sample size for FG research has been debated. Small sample sizes are not unusual in qualitative research (Patton and Cochran, 2002). It has been assumed that an ideal FG group size is eight to 12 persons (Fern, 1983) but alternatively it has been stated that an ideal group should contain 6-10 persons (Paton and Cochran, 2002; Morgan, 1996) or a minimum of six and maximum of 12 participants (Stewart and Shamdasani and Rook, 2007). Developing countries groups tend to have more participants even as many as 15 per group (Bender and Ewbank, 1994). Fern (1983) found that splitting an eight person FG into two groups of four was more beneficial to the gathering of information than the use of an eight person FG. Hence, it is extremely clear that the number of persons included in a group is quite a fluid commodity. The capability of the facilitator to run a larger group to ensure good flow of discussion could be a determinant to the limiting of the participants. There is a paucity of instruction in the literature pertaining to the number of groups that should be held (Carlsen and Glenton, 2011). Morgan (1998) suggested three to six. Anything between six and fifty has been touted (Kitzinger, 1995) and some texts actually suggest that there are no guidelines in this regard (Stewart, Shamadasani and Rook, 2007). The purpose of the grounded theory approach is to reach the point of saturation of data and this should dictate the number of groups to be held. However, there is also debate about the terminology ‘saturation’ with Glaser and Strauss (1967: 61-62, 111-112) reporting it to be ‘sample until theoretical saturation of each category is reached’ and Corbin and Strauss (1990:188) stating data collection should continue until ‘no new or relevant data seems to emerge regarding a category’. Therefore, it would appear that the process adopted dictates the number of groups needed to achieve this goal.

As the data to be collected was on a specific topic that was best understood and discussed by qualified physiotherapists private sector PTs in the Gauteng province of South Africa were initially canvassed via a bulk SASP email. Attempts were made to contact the chairperson of the public sector PT group with the aim of gaining permission to address the Gauteng group to speak to possible participants. The attempts at getting private sector participants via the SASP bulk email proved fruitless as only seven possible participants responded. The attempt to gain access to public sector physiotherapists by contacting the chairperson of the public sector PT group also was not successful due to the fact that her public sector hospital email was not working (a factor that was only found out at a later date). Using five of the original seven bulk email respondents and another participant recruited from a related practice the first FG (pilot study group) was held in a private practice establishment in Northern Gauteng. After FG1 the FG recruitment process was changed to encompass a more direct approach to the larger practices and public sector hospitals and this resulted in one other private sector and two public sector FG groups. The physiotherapy HOD at Wits was asked for permission to email PT lecturers and try to recruit participants. An academic FG group was organised in this way.

Some authors believe that familiarity affects group dynamics adversely (Payne 1976; Macfarlane Smith, 1972). However, Stewart, Shamdasani and Rook (2007) point to the fact that usually FGs are preceded by social ‘get acquainted’ or ‘warm-up’ sessions and therefore the measure of how well acquainted participants are and how this impacts on group dynamics is probably minimal. In this study it was hard to avoid professional acquaintance as a factor as the physiotherapists in each group were working in the same environment in most cases. It was hoped that the sampling methodology, although incorporating a homogeneous population of qualified physiotherapists, would result in the perspectives of such physiotherapists in relationship to different age groups, various qualification levels, years of experience, area of specialised expertise and area of current practice.

This researcher practiced the delivery of the questions in order to be well versed in their content and how they could best be delivered and adapted to different responses. It was planned that the first FG group would serve as a pilot study. Before the pilot study was undertaken the recording equipment was checked and this researcher practised with it. The way in which field notes would be taken and the way in which the FG venue would be mapped during the session was decided.

Once all the preparatory measures had been undertaken the responders for each of the FGs were contacted to arrange mutually agreeable dates and times for meetings. Suitable venues were chosen. An effort was made to hold the discussions in a venue where there would not be adverse noise interference or other disruptions. The venues in the private domain were held at a private practice location conveniently situated for all participants and the public sector focus groups were held in the PT departments of the specific hospitals. The academic FG was conducted in a seminar room close to the PT department at the academic institution. Information was supplied to all participants and any ethical concerns were addressed (Appendix 9). All participants filled in a consent form allowing this researcher to tape their contribution to the discussion prior to the start of the FG (Appendix 8). In particular this researcher maintained participants' anonymity during data collection, verbatim transcription and result reporting and participants were asked to keep the discussion content private from anyone who had not participated in that FG.

As this was qualitative research non-verbal behaviour of the FG participants and dynamics of the interactions within each FG were observed and noted in field notes by the researcher during the FG sessions (Appendix 16). Hence the field notes became a valuable tool that was utilised as an adjunct to the recorded data. With regards to the memoing process it has been said in the literature: 'In memoing, the researcher writes down ideas about the evolving theory throughout the data procedures in an effort to discover patterns' (Lempert, 2007: 245). Furthermore, writing memos should begin with the first analytical session and continue throughout the research process (Corbin and Strauss, 2015: 117).

Personal memo writing was used to direct and redirect all aspects of the research by noting ideas during the data collection and coding processes and using them to progress the collection of data going forward (Sbaraini et al, 2011; Charmaz, 2006; Lempert, 2007). Any ideas that did not conform to the general consensus were also identified and noted in memo writing. This helped drive the grounded theory process forward.

The time allocated for the discussion was dependent on the flow of information as far as possible but was usually limited to approximately one hour as the participating physiotherapists had clinical or academic commitments. The seating arrangements were designed to encourage interaction between participants. Refreshments were provided for the participants after each FG session.

The five FG discussion groups were conducted over a period of nine months from 26 September 2016 to 11 May 2017 until theoretical saturation was reached as described by Glaser and Strauss (1967).

5.1.10 Data Analysis

Descriptive data analysis was done using IBM SPSS 24 statistical package, version 24.0 (IBM Corp., Armonk, NY) to provide information on the demographic profile of study participants. This information is presented in table 5.1-5.5.

An inductive process was used to analyse the data (Cresswell and Poth, 2018; Charmaz, 2008). All data was transcribed verbatim as soon as possible after the discussion had concluded in order to allow for maximum recall of the content of the discussion and participants' behaviour during the discussion. The verbatim transcripts were recorded in Word documents. Transcribed data were analysed using a manual qualitative analysis methodology undertaken by this researcher in order to identify recurring codes line-by-line throughout. Two phases were allotted to coding being initial coding and focused coding (Charmaz, 2008). Better interaction with the data was achieved using grounded theory coding in a comparative and interactive way and line-by-line coding assisted this researcher to gain more in depth insight into participants' responses (Charmaz, 2008). Furthermore, gerunds were used in the coding process to help define descriptions of incidents or describe what is happening in a section of the data (Charmaz, 2008).

After each verbatim transcription was coded, two researchers separately identified codes. The identified codes were tabulated. To reduce the data the codes were collapsed into subcategories then aggregated into categories as a means of identifying possible final themes (Smith, 2000). As data were collected coded comparison of themes occurred to identify if they conflicted or agreed with others. Even if data did not follow the main themes they were not discarded (Portney and Watkins, 2009). This continuing process led to identification of interrelationships between groups of data and the development of a theoretical framework (Portney and Watkins, 2009). Once no more new concepts or relationships emerged and the data were repetitious theoretical saturation was reached. Initial coding of the verbatim transcripts (FG1 and FG 2) incorporated a line-by-line coding format but as the coder became more familiar with the process focussed coding came into play where larger paragraphs of relevant information even incorporating text from more than one participant were identified as pertaining to certain codes (Charmaz, 2008). This researcher undertook the initial coding of the data and then met with another

researcher who had coded the verbatim transcript separately. The first coder and second coder then compared identified codes. Discussion occurred between the researchers to arrive at a better representation of the codes and to progress the process of developing sub categories and/or categories of data. It became noticeable that as the inter coding process continued after each subsequent focus group the coders appeared to be more and more in sync until finally no differences in opinion occurred across the scheme of coding, sub categories or categories. During this process the two coders also discussed the underlying emotional, sociological or psychological factors that could be 'felt' in the way in which the participants' had expressed themselves in the text. The first coder also contributed a reflective insight into the personalities and non-verbal cues expressed by the participants in order to familiarise the second coder with the tone of the conversation in the FG during the discussion. By adding inter-coder reliability the coding process was strengthened due to reproducibility across coders (Krippendorff, 2004: Chap 11). Furthermore, the fact that both coders were physiotherapists, and aware of how gross anatomy was taught to physiotherapists in South Africa, resulted in inter coder agreement being manifested in the analysis of the data (Campbell et al, 2013). However, the direction of data collection and/or interpretation during the grounded theory process was not impacted by the imposition of their particular gross anatomy preferences by either coder. Inherent in this procedure was the principle of 'bracketing' as described by Rolls and Relf (2006) where the coders purposely ignored their own feelings on what was being revealed in the data analysis and could therefore proceed with an open mind without the occurrence of bias.

The final phase of coding of the gathered information is called selective coding. During this process the researcher links the identified categories to a central phenomenon in a systematic fashion, validation of the relationships is achieved and 'fine tuning' of categories occurs with further development and refinement as described by Corbin and Strauss (1990). The selective coding process undertaken in this thesis, the identification of themes and reporting of the relationships between them is represented by means of figures and tables. In the thematic tables the results are tabulated under the headings of: Category, Sub-category, Codes/keywords, Code frequency and Quotes to illustrate.

5.1.11 Procedures Taken to Ensure Trustworthiness of Data Collection and Interpretation

5.1.11.1 Credibility of data collection

In qualitative research concepts can be confirmed using more than one data collection method, more than one set of researchers and more than one source of data. Triangulation strategies were implemented to improve the credibility of findings e.g. *Methods triangulation* was used to check the consistency of findings between the data on the recording device and the field notes taken by this researcher. This fulfils the requirement for more than one data collection method to be used. Using *triangulation of sources* the PT service delivery FGs provided different data sources within the same method and hence provide more than one source of data within the same collection of data process. The analysis of the transcribed interviews by both this researcher and another researcher experienced in qualitative research analysis afforded the study *analyst triangulation* as two researchers analysed the data independently (Patton, 1999; Krefting, 1991)**.**

5.1.11.2 Transferability strategy

The issue of transferability in qualitative research arises when the researcher means to generalise about the topic of the research (Krefting, 1991)**.** Due to the fact that transferability is linked to the representaviness of the participants in any group taking part in the qualitative research for transverability to be verified it is important that the demographic characteristics of the sample matches the demographic characteristics of the targeted population (Krefting, 1991). This could be extrapolated to mean that those persons in a focus group should be typical and representative of the population of which they are members (Field and Morse, 1985). In this qualitative study the participants were all qualified physiotherapists working in the PT service delivery sectors in Gauteng province, South Africa. Althought the FGs were carried out in a specific province the participants were representative of the overall PT educational system in the country. Furthermore, the public, private and academic sectors were represented and the specialised areas that the participants had an interest in represented the main specialities practised within South Africa. This researcher believes that the necessary criteria for transferability have therefore been fulfilled and feels confident to use the data collected to produce a generalised opinion on the subject of the study.

5.1.11.3 Dependability strategy

Guba (1981), outlining aspects of trustworthiness for qualitative research, tabulated dependability as a naturalistic term and linked it to the scientific term reliability and

the aspect of consistency. Qualitative research methodology is detailed and in depth it therefore requires a thorough description of the pathway undertaken during the research process as this gives direction to whether or not the process could be repeated by another researcher (Kielhofner, 1982). Guba (1981) suggested that for dependability to be achieved the researcher should document the qualitative research design using step-wise description of the process undertaken. This study was conducted in such a step-wise fashion using a grounded theory approach and the trail of how the research was conducted has been laid out for each part of the FG process in detail. Furthermore, in some areas of the research the initial coding was revisited and revised as per the methodology suggested by Krefting (1991). This also strengthened the dependability of the research.

5.1.11.4 **Confirmability of strategy**

The use of triangulation, as described previously is an important methodology that can be used to confirm the strength of a strategy (Krefting, 1991). An external audit process is also important in confirmability of strategy. Guba (1981) suggested that the records be audited under six categories.

- Raw data (including audio and video recordings and field notes)
- Analysis of data and/or reduction of data processes (including summaries)
- Production of categories of themes and how these are interpreted and inferences made from them
- Process notes (including notes on trustworthiness and design and procedure formats)
- Study proposals and records of field decisions
- Development of tools/instruments

This study produced audio recordings and field notes that are available for audit. The field notes for each FG are presented in Appendix 16 of this thesis and the audio recordings can be produced on request.

Verbatim transcriptions of each FG were made within the first few days after the conduction of the discussion. Each of these Word document transcripts were coded (using colour coding) in the period immediately after the transcription and this information was tabulated using the colour coding formula. This procedure was undertaken for each FG and as the new codes were added to the tabulation it was clear to see to which FG the information was allocated due to the different colours being used to distinguish each particular FG. These verbatim transcripts although not included in this thesis can be observed on request.

The development of sub-categories and categories occurred in tandem with the coding tabulation and developed exponentially as new information, deductions and inferences became apparent. The final themes emerged after all the categorised collected data was further scrutinised. The main coding tables are not included in this thesis but are available for perusal on request.

The process notes for this study were included as personal memos where comments relating to the carrying out of the process and matters arising from it were 'discussed' by the researcher in order to formulate the way forward for the research and advance the grounded theory data collection process in a measured manner. The personal memos can also be supplied on request.

The fact that a second researcher provided analyst triangulation and that this study was subject to scrutiny by two further researchers in a supervisory capacity provides it with some auditory credibility and attests to the fact that the research design and methodology should be confirmable.

Hence, the four strategies that proport to validate trustworthiness in qualitative research design and methodology have been utilised in this study and therefore the research should be reproducible, strong and valid.

5.1.12 **Results**

5.1.12.1 **Distribution of the five focus groups by service delivery sector**

Focus group1 and 3 had participants from the private sector.
Focus groups 2 and 4 had particpants from the public sector.
Focus group 5 had participants from the academic sector.

5.1.13 **Focus Group Mapping, Field Notes and Memo Writing**

In all FGs the participants sat in a circular formation together with the facilitator.
The seating was always comfortable and allowed for easy interaction between the participants. A record of the mapping of each FG is available on request. It is noted that in FG 3 (private sector) where the practice manager took the lead the manner of participation was very ordered in a clockwise direction during the first responses to the initial open-ended question. This phenomenon was also seen in the academic FG where each participant in turn followed after the previous one in a clockwise direction with the exception of participant 7 who was a little late for the discussion and fitted

into the circle where there was a vacant seat. In the other four groups the order of participation was random from the beginning of the discussion.

5.1.14 Pilot Focus Group

Focus group 1 served as a pilot study. However, due to the fact that the FG 1 discussion resulted in an easy flow of conversation between participants and collected useful information it formed a good foundation for the continuation of the grounded theory methodology. Hence, the collected data were included in the analysis of results.

5.1.15 Demographic Information of Focus Group Participants

Demographic data from the five focus groups were pooled and analysed in relation to PT service delivery participants. Table 5.1 illustrates the number of participants in each FG and the number of FGs held in the various service sectors

Table 5.1: Number of Participants and Number of Focus Groups in each Service Delivery Sector (n=32)

Service delivery sector	Number of participants (n)	Number of focus groups (n)
Public	14	2
Private	11	2
Academic	7	1

In Table 5.1 it can be seen that most participants came from the public service delivery sector. However, there was not a large discrepancy in numbers between the number in that category and the private service delivery sector.

Table 5.2: Summary of Demographic Information for Age and Years of PT Experience for all Participants (n=32)

Variable	Participants (n)	Range Minimum to maximum years	Median Years (IQR)	Mean Years	SD
Age	32	22-48	27.0 (9,0)	29.9	± 7.8
PTE	32	1-25	3.0 (6.5)	7.4	± 7.7

- IQR: Interquartile range, PTE: Physiotherapy experience, SD: Standard deviation

Table 5.2 illustrates that the average age overall was 29.9 (±7.8) years with average number of years of experience for participants being 7.4 (±7.7). However, the median

value of 3.0 (with an Interquartile range of 6.5) does suggest that the number of years of PT work experience was not equally distributed in the sample.

Table 5.3 gives further insight into the age and experience demographics of the focus group sample. These results indicate that average age for the public sector participants of 24.2 (±2.4) years indicated younger physiotherapists than that for private sector category of 34.6 (±8.0) years and in the academic sector 33.9 (±7.8).

Table 5.3: Summary of Demographic Information for Age and Years of Physiotherapy Experience for PT Participants in Each Service Sector

Variable	Service delivery sector	Participants (n)	Range Minimum to maximum years	Median Years (IQR)	Mean Years	SD
Age	Public	14	22-31	23.5 (2.0)	24.2	± 2.4
	Private	11	25-48	30.0 (13.25)	34.6	± 8.0
	Academic	7	25-47	33.0 (7.25)	33.9	± 7.8
PTE	Public	14	1-2.5	1.0 (1.0)	1.4	± 0.6
	Private	11	2.5-25	8.0 (10.0)	12.7	± 7.3
	Academic	7	3-25	8.0 (8.75)	11.1	± 8.1

- IQR: Interquartile range, PTE: physiotherapy experience, SD: Standard deviation

This was probably due to the fact that half (50%) of the public sector physiotherapists were doing their community service year and were newly qualified phyiotherapists. Logically this meant that the average amount of clinical PT experience was greater in the private sector and academic sector.

Table 5.4: Qualification and Gender of Participants in Different Service Delivery Sectors

Service delivery sector	Physiotherapy qualification n(%)			Gender n(%)	
	Bachelors	Masters	Doctorate	Male	Female
Public (n=14)	14 (100%)			2 (14.3%)	12 (85.7%)
Private (n=11)	6 (54.5%)	5 (45.5%)		2 (18.2%)	9 (81.8%)
Academic (n=7)	2 (28.6%)	3 (42.9%)	2 (28.6%)	2 (28.6%)	5 (71.4%)

Table 5.4 shows the trend towards increased academic qualifications in the private sector and the highest qualifications are attributed to the academic sector. There is a distinct tendency for the majority of physiotherapists in each sector to be female.

Male to female ratios for this trend are 1:6, 1:4.5 and 1:2.5 for the public, private and academic sectors respectively.

Table 5.5: Number of PT Focus Group Participants in Each Service Delivery Sector Working in Six Identified Clinical Areas

Service delivery sector	Clinical work area n (%)					
	NMS	Orthpaedics	Paediatrics	Adult neurology	CP	CH
Public (n=14)	5(36%)	3(21%)	5(36%)	5(36%)	1(7%)	
Private (n=11)	7(64%)	7(64%)	5(45%)	1(9%)	4(36%)	
Academic (n=7)	3(43%)		2(29%)	2(29%)		1(14%)

- NMS: Neuromuscular –skeletal, CP: Cardiopulmonary, CH: Community Health.

Table 5.5 records the clinical areas in which the focus group particpants work. Some participants work in more than one clinical area. This is reflected by the fact that there are more participants in each clnical area than are represented in the total number of participants for each service delivery sector. The percentage participation also indicates that some participants are engaged in more than one clinical field.

Section 5 provides information regarding the themes generated within the FGs. show Schematical representations of themes and tables are presented in Figure 5.2 to 5.8 and Tables 5.6 to 5.12 illustrate themes categories, sub categories and relevant quotations.

5.1.16 **Themes Generated by Focus Groups 1-5**

The collapsing of the categories identified during the inductive process led to the development of seven themes.

The themes identified are:

Theme 1: The ‘Bare Bones’ of Anatomy

Theme 2: Anatomy: ‘A Touching Experience’

Theme 3: ‘Staff Matters’ in Anatomy

Theme 4: ‘Student Embodiment’ in Anatomy Education

Theme 5: Gross Anatomy Classes

Theme 6: ‘Time is of the essence’

Theme 7: ‘Anatomy Know How’ for Physiotherapy Practice

Selective Coding for Theme 1: The 'Bare Bones' of Anatomy

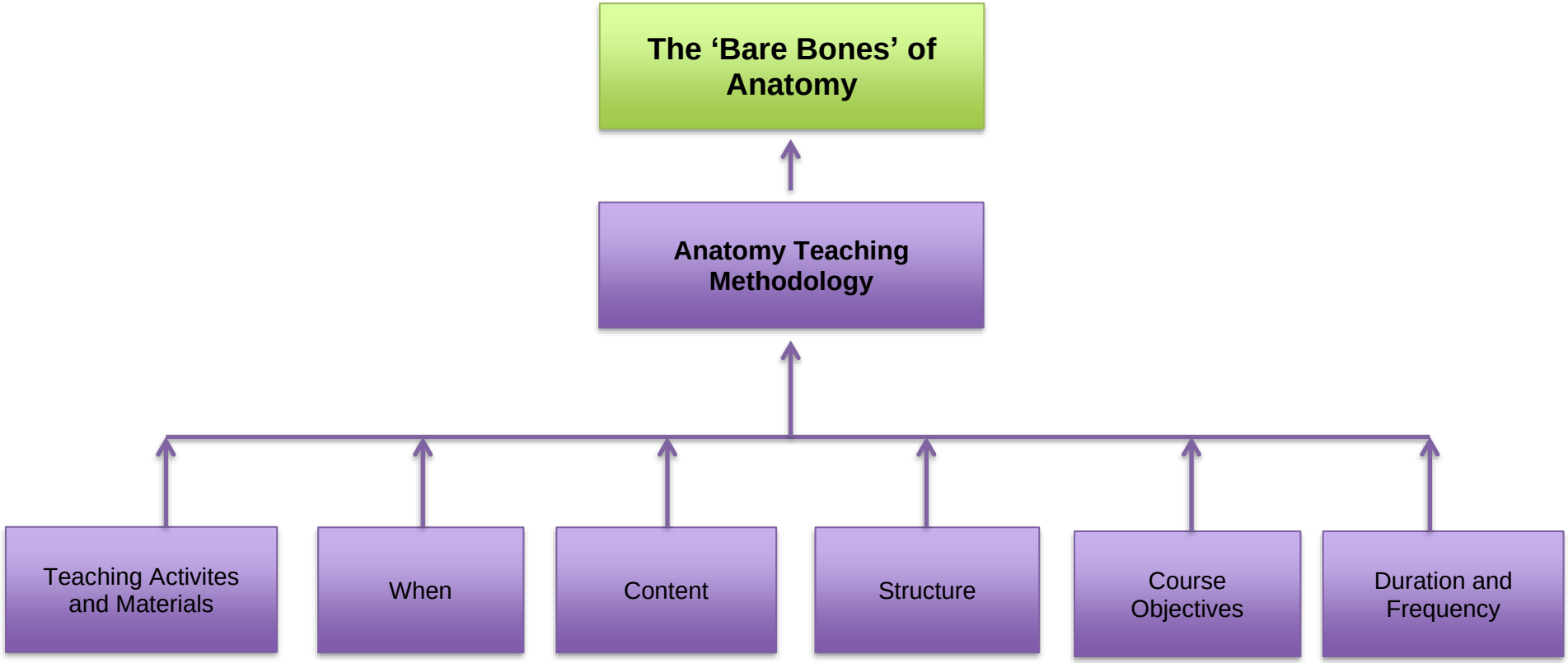

Figure 5.2: Schematic of Theme 1: The 'Bare Bones' of Anatomy, Category and Sub-Categories

Table 5.6: Theme 1: The 'Bare Bones' of Anatomy

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Anatomy Teaching methodology	Content	Spinal cord Muscle Brain Osteology Name Upper limb Lower limb FASCIA GIT Brachial plexus Nerves Bones Lungs Intestines Organs Blood supply Chest Greater and lesser omentum Villi Gluteus Maximus Back of the Muscles Skeleton Soft tissue Thorax Spinal Tracts Do the whole anatomy. Don't cut things out We did everything	19(23%) 19(23%) 12(14%) 9(11%) 7(8%) 6(7%) 6(7%) 3(3%) 3(3%) 3 (3%) 3(3%) 2(2%) 2(2%) 2(2%) 2(2%) 2(2%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%)	*'… I think definitely more spinal cord things. It goes together with brain and all the tracks. I remember I had no clue of what was happening with those tracks ' (FG3, Quote154).* *'They spent most of the time for us on upper limb and lower limb and then they had lesser amount of time with the other like structures that are important but not specifically the most important ones. So that was nice' (FG 5, Quote 135).* ***'Fascia**…you just cut that thing away so you could go to the muscle and try and get the muscle as best you could' (FG3, Quote, 189).* ***'Ya!** The lungs are really important for us like to learn the anatomy but I think like learning about all the intestines… of course you need to know the basics but I think we went into way too much detail' (FG2, Quote 146).* *'Now looking back I understand just do the whole anatomy. Don't cut things out. You have to know full anatomy to be able to clinical reasoning but while I was in it I couldn't understand what the hell we're going to do with all this… and we did everything from the top of the head to the base of the toes…um…and I think it does give you a very composite picture' (FG5, Quotes 129, 132).*
	Course objectives	Goals Identify Objectives fulfilled	1(33%) 1(33%)	***'…**We were given sort of…um… goals to meet each week where we had to dissect…for example…the shoulder by end of week two, elbow by week three or whatever…' (FG 2, Quote 13).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	Duration and frequency	Two years (of integrated anatomy)	2(12%)	*'…Then there were also tutorials I think once a week' (FG6, Quote 9).*
		Dissect three days a week	1(6%)	
		Dissected four mornings a week.	1(6%)	*'…3-hour lectures a week and one two-hour practical…' (FG1, Quote 15).*
		Two hours (of dissection)	1(6%)	
		Dissected every Friday	1(6%)	*'Before we started dissection there was a fifteen minute to half an hour session with the table doctor of specifically what was going to be covered that day, what to look out for any…any specific…areas ' (FG6, Quote 21).*
		Fifteen minute to half an hour with the table doctor	1(6%)	
		every dissection day for preparation	1(6%)	
		Tutorials once a week	1(6%)	
		Tutorials twice a week	1(6%)	
		Lectures every day	1(6%)	
		Lectures most days	1(6%)	
		One two-hour practical a week	1(6%)	
		Three –hour (lectures) a week		
	Structure (in relation to knowledge, understanding and recall)	Two observational prosections a week	5(42%)	*'First year it was lower limb. Second year it was upper limb …we did a little bit on the brain…. both the theoretical part and then dissection at the same time depending on the module ' (FG4, Quote 13).*
		Finished at five every day-exhausting!	2(17%)	
			2(17%)	
			1(8%)	*'So our anatomy was broken up into four different quarters and the first quarter was the bones, second quarter muscles, third quarter was systems and the fourth quarter was I think …the brain ' (FG2, Quote 14).*
		Broken down into different modules/sections	1(8%)	
		Quarters/ quarters	1(8%)	
		Compartmentalised		
		A year module	1(8%)	
		No fancy modules	1(8%)	
		Very structured		
		Couldn't pick up any information		
		Upper limb dominates		
		Tons of Apps'		

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	Teaching activities and materials	Dissection Lectures Cadavers Plastinated models Draw Prosection Tutorials Netter's Atlas Museum Computer Atlas Practical sessions Spots Grays' Video Moore's Anatomy TV Real Prac manual 3D Visualisation 'Biltong Book' Textbooks Muscle tables 'Picasso' Blackboard Ancient printed notes Bag of bones 'James' skeleton Not treating computer Library books	24(41%) 15(26%) 12(21%) 10(17%) 9(16%) 8(14%) 7(12%) 8(14%) 6(10%) 6(10%) 5(9%) 4(7%) 3(5%) 3(5%) 3(5%) 2(3%) 2(3%) 2(3%) 2(3%) 2(3%) 1(2%) 1(2%) 1(2%) 1(2%) 1(2%) 1(2%) 1(2%) 1(2%) 1(2%)	*'We used to do our own dissections but then in the front of the hall…I don't know if it was the same for other years but in the front of the hall we had a cadaver that was done properly so like not us tearing and ripping (some laughter in the group) and cutting and slipping and slicing wherever but it was like done proper, proper that you could also go and look at…um…so that …that was slightly more useful than when I felt I don't know in dissection' (FG4, Quote 41).* *'We had a similar thing…we call it… IT'S HORRIBLE…(Laughter from the group). We called it the 'biltong book' but it was open like twenty- four hours. You'd swipe in with your student's card but then the lecturer who taught anatomy would go before…like a week before the test…say this week we're doing upper limb …she'd like rotate and move things around so like it's all the upper limb things so it's easy for you to go there in your free time and revise upper limb because all the upper limb were like sort of displayed and marked so that helped a lot. That really, really helped' ((FG4, Quote 36).* *'We had a …a guy. I don't know his name now but we called him 'Picasso' because he loved to draw. He'd start from literally…and draw each thing …' (FG3, Quote 109).* *'Oh James! (Group laughter and unintelligible chitchat)' (FG1, Quote 76). 'It's a skeleton. So they used to put it in front of the class' (FG1, Quote 78).* *' Because your not treating your computer so it changes it completely (Pause) if you (Pause) even if you take your cadaver, it doesn't look exactly the same and the position isn't exactly the same not that anyone's position is exactly the same but Ya! But it's a good add on though.' (FG1, Quote 262).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	When (timing)	First year (anatomy) Afternoon Second year (anatomy) Friday Monday Thursday Wednesday Morning Tuesday Weekend Basic anatomy first year. Redo fourth year Third year go back to labs Intertwined anatomy	15(48%) 11(35%) 10(32%) 9(29%) 6(19%) 5(16%) 4(13%) 3(10%) 3(10%) 2(7%) 1(3%) 1(3%) 1(3%)	***'…****We did first year anatomy' (FG3, Quote 8).* ***'****We did it in our second year and it was a year module…'. (FG4, Quote 14).* ***'****But then we had anatomy and physiology intertwined so over the two years we did anatomy and over the two years we did physiology.' (FG2, Quote 128).*

The codes that appeared most frequently in identified subcategories were:

Teaching activities and materials: The code ‘dissection’ (n=24, 41%) occurred most frequently in both this sub-category and in the overall category anatomy ‘teaching methodology’. An atlas (n=5, 9%) and particularly Netter’s atlas (n=8, 14%) was frequently used for reference. Although the code ‘computers’ was quite well supported (n=6, 10%) one participant made a relevant remark pertaining to the use of computers in the learning of anatomy in relation to its clinical relevancy.

Content: ‘muscle’ (n=19, 23%) and ‘brain’ (n=12, 14%) were the leading codes in this sub-category. Physiotherapists need to know muscles very well and a participant noted that the brain was not adequately covered. Interestingly the role of fascia and the way it was dealt with in the past is clear from a quote by a participant in FG3. A participant in FG6 raises the question as to whether we can be very selective in the content we include in a gross anatomy curriculum for undergraduate PT students and recommends that everything should be covered to establish a ‘composite picture’ of human anatomy.

When (timing): ‘First year anatomy’ (n=15, 48%) was the most frequently identified code in this sub-category with ‘Friday’ (n=9, 29%) and afternoons’ (n=11, 35%) identified frequently as well. Participants had first year anatomy (n=15, 48%), second year anatomy (n=10, 32%) and there was only one code referring to ‘intertwined anatomy’ (n=1, 3%).

Structure: ‘Broken down into different modules’ (n=5, 42%) was the most frequently reported code in this sub-category. The division of the workload was *‘compartmentalised* ‘*(FG4, Quote 32)*.

Selective Coding for Theme 2: Anatomy: 'A Touching Experience'

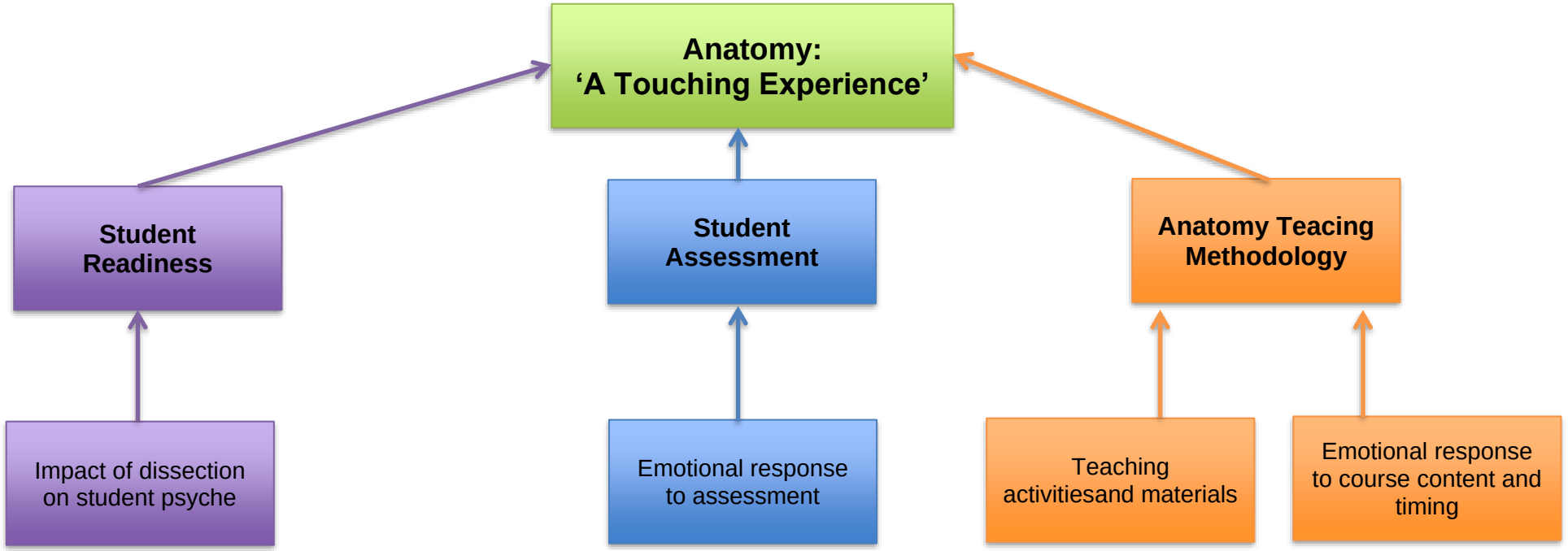

Figure 5.3: Schematic of Theme 2: Anatomy: 'A Touching Experience', Categories and Sub-Categories

Table 5.7: Theme 2: Anatomy: 'A Touching Experience'

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Anatomy teaching methodology	Emotional response to course content and timing	Emotion over anatomy load I loved it Drop out of degree Desperation Anatomy is information overload I cringed the first day I enjoyed it a lot as well Troubles with the blackboard Most people incentivised Major shortcoming No clue in your first years. Cadavers… freaked me out Struggle and a challenge	3(8%) 3(8%) 1(3% 1(3%) 1(3% 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%)	*'I would like (and she gives an embarrassed laugh)…I would cry about that thing and I never cry …I NEVER CRY…like someone else …I was crying and I'd phone my mom and she's like (in a soft voice) " Just go back and sit down and study" and like that would not be the answer that I was looking for you know. That…the load…it's so much and they cram it all into like one year…um…' (FG 4, Quote 187)* *'I cringed the first day (laughs nervously)…um… but I thought it was really good to actually visualize…because I'm… I don't know about you guys but I'm one of those sort of people that learns better by looking at something and visualising it…so I thought the cadavers were good' (FG2, Quote 109).* ***'**Those Wednesdays were very good when we went to those like…you'd go there and look at all the specimens…not the cadavers…that like freaked me out but looking at this…actual pieces of body as gross as that sounds like…" (FG 4, Quote 43).*
	Teaching activities and materials	Surface anatomy Really useful tool Relevance to depth of structures	4(8%) 1(2%) 1(2%)	*'We had to draw on each other. So we were in groups and we had to draw on each other …um...different muscles and they would correct us and I found that really useful' (FG2, Quote 166).* ***'**I think with us they just told us you've got to get the surface anatomy we're going to start there. And that's where we started. It was never why surface anatomy's important. Why do you need to have a starting point to get to the deep end. That's why I think the dissection was a mess because the minute you cut in, your cutting into everything that's superficial and important (laughter from the group)…and your suddenly then at the deepest muscle and your like …ugh…that's it I found it. So I think no one ever touched on surface anatomy in terms of like …things are very superficial …you need to look or things are either like very deep in and you need to cut a bit deeper so I think that was why dissection was also a bit too deep because you didn't actually know what you were doing. What is surface anatomy? How deep or how superficial is it?' (FG4, Quote 76).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Student readiness	Impact of dissection on student psyche	Face Smell Ring Enjoyed dissection Mom Crying and emotional Not real Cadaver stories Looks like a 'dolly' Deregistration Hand Disgusting Feeling queasy Very seriously Terrified Cadavers freaked me out Putting scalpel into a real person Nonchalance Apprehension Acceptance Ghost stories Scary Association with a meal Fear Being able to see the cadaver's face made it all too real! Seeing cadaver's face was not upsetting Still remember cadaver's face Huge impact of knowing the cadaver as a person. Cadaver looking like (recently) deceased family member/traumatising Any family member missing?	7(8%) 7(8%) 3(3%) 3(3%) 2(2%) 2(2%) 2(2%) 2(2%) 2(2%) 2(2%) 1(1%) 1(1%) 1(!%) 1(!%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%)	*'…Then my mom and my sister are not medically inclined at all so I literally had to strip myself down outside the house and shower outside in like commercial quarters and stuff before I was allowed inside the house because they couldn't take the smell ' (FG3, Quote 103).* ***'**Even…even to me it was…it was not that emotional but I got emotional once when I saw a cadaver with a ring (participant seems emotional even relating this incident) …I was like this person…where's the wife here? And I felt so emotional because I thought okay maybe this person was lost and whatever…maybe they take this person. So I got attach with that because get me many thought about it and what's happening around this person and it's better just get a killed cadaver without anything on it …that's it and then you're just dissecting and you're thinking …Aye! It's a dolly…. And then just you know…someone here…you know and….' (FG4, Quotes 188,191,193).* ***'**I know like also I'd never look at the cadaver's face because the moment I'd look at their face to me that made them a person. Like we all have arms…all have legs…all have bodies…but it's like your facial features that make you an individual. … even though I know that is a human being I didn't want to see them. I didn't want to know what they looked like before or who they were like that would have made it…it makes it too real ' (FG4, Quote 195).* ***'**I remember very clearly …so our cadaver …er…was you know exposed…covered with a sheet and you'd remove to use the arm and the leg, whatever but the face had a separate cloth over and they did say to us you can choose to look or not look. I think we didn't dissect the face or if so we did for a very limited amount of time… And also on the wall there was your cadaver number and what they died of and I …I can still see the cadaver's face very clearly. Never mind the anatomy and any of that I can…you know I remember when I looked…I wasn't upset by it …yeah I chose to look…and I wasn't upset but I know what his face looked like. I can…you know…I remember it very clearly and it was quite a big impact knowing what he died of. So he had died of skin cancer and …um…and as we were dissecting and especially when we*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
		Psychological counselling The 'Gangster' Pride in cadaver uniqueness Fascination Association with organ donation	1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%)	*were removing the skin underneath the amount of things spread everywhere and how badly riddled he was and that had a huge, huge impact on me knowing him as a person as opposed to just…once they're open and your working with …someone you don't recognise…um…it was easier to sort of separate that but putting a disease and a face to him made it more impactful but not upsetting' (FG5, Quote 112).* ***'**The thing that was also hectic for me was that one of my friends lost their grandmother …um…during the dissection right at the beginning and she was…her cadaver was female and looked just like her grandmother so for her to go back to dissection was quite hectic after that so it was quite emotional for her and for me …' (FG3, Quote 103).* ***'**I… I remember…I remember going home and asking my family that …um…if anybody like had died or…or that they had lost track of 'cos I remember…you know how stories go around when you're a student. I remember specifically they said that there was a girl who, you know, was there and her uncle was lost somewhere and she was dissecting and then she opened up the face and it was her uncle so I specifically remember going home and asking… Is there anybody that you know in our family' (lots of laughter in the group) (FG5, Quote 116). **(**Interrupting) '… that you are missing?' (FG5, Quote 117).* ***'**I just wanted to add to what (mentions P6 by name) was saying with not for yourself but with colleagues deregistering so there was also a girl, friend of mine in OT who deregistered because of anatomy. She a few years before had been a rape victim and this was the first time she was coming into contact of bodies and genitalia and it just brought too much that she…that she…she left OT altogether' (FG5, Quote 123).* ***'**With us…it was our cadaver that everybody was fascinated at …by…because he was a gangster (group laughter). We found out retrospectively so he had all these tattoos and lots of people came to have a look at the tattoos rather than us dissecting and…um…it was you know …it only really hit hard that he had lived his life and*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				you know…he participated in society… when we discovered that he had a plate on his arm. So he had fractured his arm before. So everybody wanted to see the plate '(FG5, Quote 125).
Student assessment	Emotional response to assessment	Stressful Traumatic 'It was terrible… really bad' 'Massive problem' Negative perception of anatomy Really enjoyable That would peeve me 'Threw everyone' You know that little time that you are given to point certain muscle. It's… UGH! …	1(11%) 1(11%) 1(11%) 1(11%) 1(11%) 1(11%) 1(11%) 1(11%) 1(11%)	*'I think that was like really traumatic that we got asked about the lower limb when we had only done the upper limb and I think it just gave everyone a really bad feeling about anatomy…in our first, first test so I think that started with anatomy being a negative thing because you couldn't… there was just too much to do that you couldn't do actually anything. 'Cos they'd be focussing on something but you'd be worrying about something else so it was a massive problem. I remember that question about the ligaments in the knee and it was terrible…it was really bad…' (FG2, Quote 20).* ***'** It was really enjoyable and the moment that you know that you've exempted or promoted you really feel good about yourself' (Pause)(FG2, Quote 37).* ***'**I think on our side (some group laughter) …I think on our side spots are …you know…it was helpful but at the same time…You know that little time that you are given to point certain muscle. It's… UGH! ...It's very difficult to spot a muscle when you see a muscle are diff…are the same you know and nerves and nerves and arteries…I mean veins and then I think that time it's …it's so little. It's just like it's five …five seconds or something like that…'(group laughter) (FG4, Quote 105).*

Theme 2: Anatomy: ‘A Touching Experience’ emphasised both the physical and psychological dimensions of such ‘a touching experience’.

One code that appeared most frequently in Theme 2 related to the impression that a cadaver’s face (n=7, 8%) made on the student psyche during dissection. Together with the hands (n=1, 1%) and the sight of a wedding ring (n=3, 3%) awakened the students’ to the ‘human reality’ of the cadaver. Before undergoing this type of realisation students were able to regard the cadaver as *‘… not real by the time you see them’ (FG3, Quote 341)*. The other highest code frequency under this sub-category was ‘(Hate) smell’ (n=7,8%) and it was associated with awkward social interactions.

A number of codes ranked equally within this theme. One that encompassed many aspects of the students’ relationship with their cadaver was ‘Cadaver stories’ (n=3, 3%).

‘Emotion and crying over anatomy load’ (n=3, 8%) fell into the sub-category relating to the emotional response to course content and timing. Anatomy workload was identified as a really emotional burden for students. The tactile code ‘surface anatomy’ (n=3, 6%) rated on a par with the two previously mentioned codes and was linked to clinical matters.

Although certain codes did not show a high frequency individually they stood out as having particular value. These related to ‘cadaver looking like recently deceased family member/ traumatising’, feeling ‘apprehension’, being ‘terrified’ and finding the experience ‘scary’.

The sub-category ‘Emotional response to assessment’ resulted in participants offering both positive and negative comments regarding this aspect of the course.

This theme uncovered many codes that show that the psychological wellbeing of the student is extremely important in the conduction of gross anatomy education and can impact on how the student copes with their anatomy course.

Selective Coding for Theme 3: 'Staff Matters'

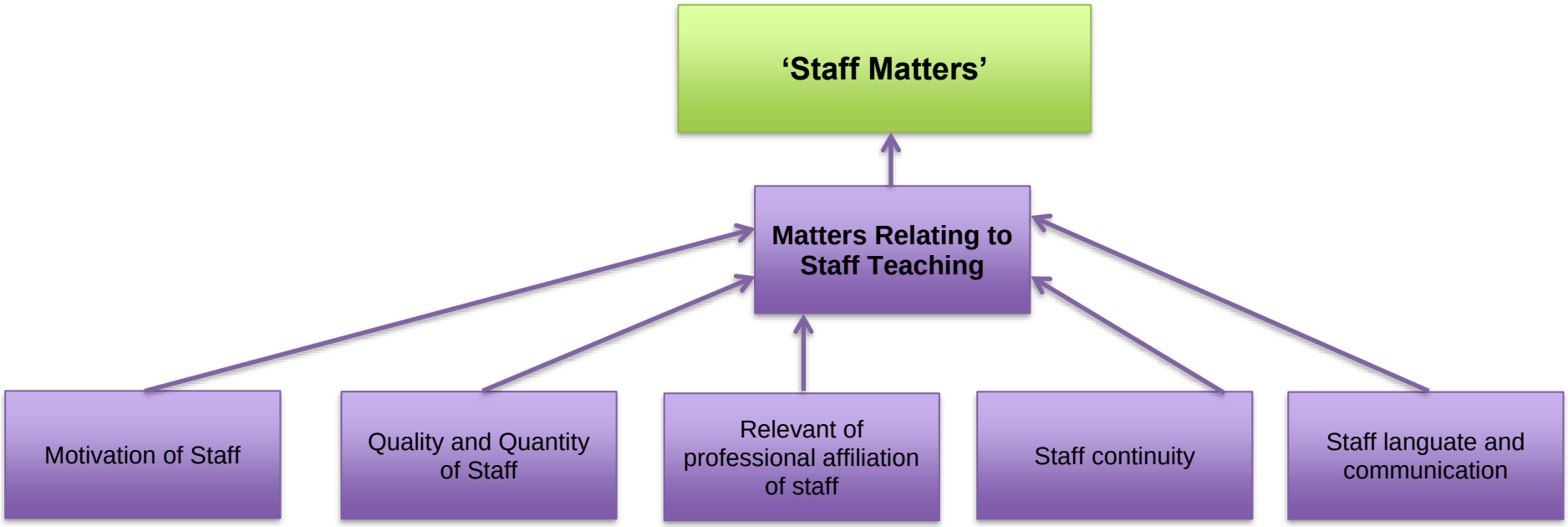

Figure 5.4: Schematic of Theme 3: 'Staff Matters', Categories and Sub-Categories

Table 5.8: Theme 3: 'Staff Matters'

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Matters relating to staff teaching	Motivation of staff	Passionate lecturers Gurus Substandard Amazing lecturer Physio TA made dissection clinically relevant Allen and Tobias had passion and commitment. Very funny professors Professor helped by making tables Professors wrote books and articles Professor made summarised booklets Lecturer who did basics only Student struggled to follow Helped to prevent guessing	3(18%) 2(12%) 2(12%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%)	**'***Um…for learning…our um…professor…or…doctor he helped us by making tables so…um… that really helped …um…so muscle tables especially so say like put in a muscle, insertion, origin, nerve supply whatever and then he'd say if you know…you know the basics of that…the tables… then …and it really helped like because you can get so confused and it is kind of parrot learning …' (FG2, Quote 40).* ***'I…I enjoyed the theory and the prac equally. I think for the theory part it was because we were taught by gurus…um…very funny professors who'd written books and articles and everything and during lectures they were very passionate you could see ' (FG5, Quote 38).*** ***'For me I thought the…the…teaching that was provided to us was more substandard compared to what medicine and the other groups were receiving. Even lecturers they knew their work but you could see that they were just doing it because they were asked to do it. They are not putting a lot of effort. Not giving much attention to us' (FG5, Quote 36).*** ***'I found that the tutors that they helped us like …not the tutors the assistants…like when we were with (refers to the Fa) for example…um…like they were just…instead of just guessing …okay well…the prosection for example.. okay well I think this is that head of biceps or it could be the other head…not sure…instead of actually just guessing they were like no it's this…um…this is how you look out for it . So them actually telling you what exactly it is rather than you guessing that really helped me a lot' (FG4, Quote 91).***

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	Quality and quantity of staff	Staff to students poor ratio Need more teaching assistants and staff GUIDANCE needed Need more assistance Not enough supervision Vie for attention One per station ideal Academic perspective …not feasible Have to crowd around one cadaver Rush through work No chance to pick up information Lost 'Don't think they had good training' More tutors needed Grab tutors attention One table doctor per four tables We always felt that it was fine Someone nearby to help Lecturers knew their work Lecturers were very good Led down completely incorrect path"	4(17%) 4(17%) 3(13%) 2(9%) 2(9%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%)	***'…****There were also staff members…I can't remember what they were called…who would go around and be available from station to station to help you with …um…the dissection…and I remember as a student always we'd really have to vie for their attention for how many students we were and how many assistants…dissection assistants that were … there were …it felt as a student… from a student's perspective a poor ratio 'cos it…we'd would have liked to have gotten more questions in '(FG5, Quote 11).* *'I think we had teaching assistant, one or two in the class and the lecturer would be there but (Pause) Ugh! They didn't really help much. I don't think they had good training at that stage. Ya! So it would have been better if they had proper training 'cos they would just stand in the corner and you know whatever' (Laughter from the group) (FG1, Quote 97).* ***'****I can't remember how many assistants there were but we …I know that we always felt that it was fine …ya. If you needed help there was always someone close by' (FG3, Quote 330).*
	Relevance of professional affiliation of staff	Makes more sense if it's a physio teaching Need to link anatomy to the physio profession with examples Quicker and nicer to be taught by a professional physiotherapist We brushed through surface anatomy If taught by a surgeon they will not realise the relevance of surface anatomy to physio profession. Physio table doctor relates dissection to clinical cases.	1(10%) 1(10%) 3(30%) 3(30%) 1(10%) 1(10%) 1(10%)	***'****Our table doctor was a physio so she related a lot of what we were seeing and doing to patients we would see in the future so that made it quite relevant to us so I really, really enjoyed the dissection…' (FG5, Quote 33).* *'We had a medical doctor actually teaching us like anatomy so it makes much more sense when it's a physio that is going to then because he's able to come up with examples that will actually help you…'(FG4, Quote 53).* ***'…****and when we did anatomy it was such a basic overview of the lungs that there's no like…it doesn't*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				link up…it doesn't connect so for one you're learning this extreme detail…for the other it's not as applicable where it would be nice if a physio's teaching you then they'd know the depth that you need to go in so they can say like this is not important' (FG4, Quote 53). ***'**I think it also goes back to the fact that your not taught by a physio…because I do know that we went in but we really brushed through the surface anatomy. They would tell you like …this is the skin…adipose tissue and all the body but it's just brushed through and then they start like focussing more on all the muscles and all that' (FG4, Quote 78).*
	Staff continuity	Every tutor group was different No specific teaching Lecturer had been teaching anatomy for centuries… Lecturer established…created summaries Staff changes Very disruptive	1(14%) 1(14%) 1(14%) 1(14%) 1(14%) 1(14%)	***'**"So ours was quite disruptive through our year our staff changed literally every semester. So it was quite disruptive and even our small tutor groups that we had … So we never actually got used to one specific style of teaching …which made it very difficult ' (FG3, Quote 26).* *' He'd been teaching anatomy for don't know…centuries now (laughter from group members) I'd like to say that he'd been there for quite a long time (FG4, Quote 59).*
	Staff language and communication	Poor English Foreign staff Battled to hear Could not understand Heavily accented It's a nightmare! Sound does not travel	4(50%) 3(38%) 2(25%) 2(25%) 1(13%) 1(13%) 1(13%)	***'**We also had a…some lecturers that really we could not understand (Laughter within the group)…anything they were saying 'cos they said they were speaking English but …' (FG3, Quote 27) (Interrupting**)*** *' Our experience was there was one in particular that…um…we struggled to understand his English. He was a foreigner and he was very, very heavily accented and everyone didn't understand what he was saying' (FG5, Quote 45).* ***''**So there weren't enough cadavers…your lecture hall's not big enough and then it goes all the way to*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				the back and you can't hear the lecturer properly because the sound doesn't travel out and you can't see the screen…oh! It's a nightmare!' (FG3, Quote 327).

Theme 3: 'Staff Matters' aptly describes how instructors that teach students influence their learning experience either in a positive or negative way. In the sub-category 'Quality and quantity of staff' equally rated codes were: 'Need more teaching assistants and staff'' and 'Staff to students poor ratio' (n=4, 17%). Participants across FGs expressed the wish that more staff would be available to assist especially during practical sessions and that teaching assistants were not adequately qualified.

In the sub-category 'Staff language and communication' the leading code was 'Was like they weren't speaking English' (n=4,50%). Students really seemed to have a problem with foreign lecturers (n=3, 38%) with heavy accents (n=1, 13%)

Under the sub-category 'Motivation of staff' some lecturers were termed 'passionate' (n=3,18%) (FG5, Quote 38). Others were designated as 'gurus' (n=2, 12%) (FG5, Quote 33) or 'amazing' (n=1, 6%) (FG2, Quote 21). There appeared to be a preference for physiotherapists to teach anatomy to PT students (n=3, 30%) detected in the sub-category 'Relevance of the professional affiliation of staff ' and this was linked to making anatomy more clinically relevant. The overall note of this category was one of negativity regarding staff and the way they were taught anatomy. However, occasionally truly gifted teachers created a learning environment that stimulated students to perform well.

Selective Coding for Theme 4: 'Student Embodiment' in Anatomy Education

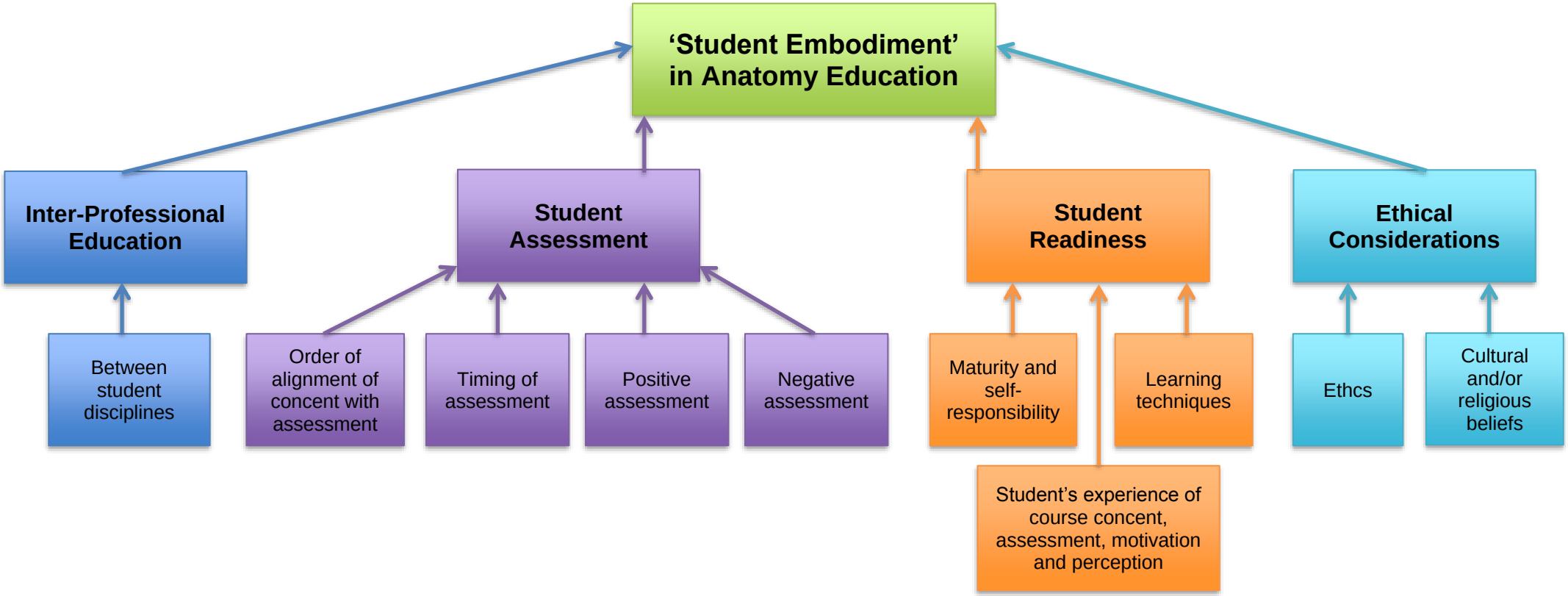

Figure 5.5: Schematic of Theme 4: 'Student Embodiment' in Anatomy Education, Categories and Sub-Categories

Table 5.9: Theme 4: 'Student Embodiment' in Anatomy Education

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Student readiness	Maturity and self-responsibility	Lack of serious attitude Fun Age is a factor First year lack of maturity Not incentivized Blasé No clue' Ha! Ha! Ha! Now we've all got drawings on ourselves Expect too much from 22 year old selves I just turned seventeen in second year Had to mature quickly	6(33%) 3(17%) 3(17%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%) 1(6%)	***'*** *not everyone's cadaver was perfect because not everyone's method…but then sometimes we had cut away at what we were meant to find (giggles) and then we would say we couldn't find it because we had already lost it. So…' (Pause) (FG3, Quote 36).* *' I had a funny experience. I was very dedicated in my first year, first weeks and I remember working 'vooruit skryf' and then I summarised the things and I left out all the detail because the names were just too long. So I just left it out! (General laughter from the group). 'Cos you didn't understand what it meant to have a flexor carpi radialis brevis. So when we actually got to the stage where they explained what the, what the Latin means it was oooh! (With a facial expression indicating surprise) You have to have all the parts! (This evokes lots of laughter from the group)' (FG1, Quote 37).* ***(****Referring to surface anatomy****) '****Okay quickly draw this and it was… we were all like Ha! Ha! Ha! Now we've got drawings on ourselves (laughter fro the group). Why? Why would we? Oh! Oh! What is this? We wouldn't be able to answer you so it was also done…everything was done very quickly…' (FG4, Quote 80).* *'So I think that doing it in first year at (mentions the place) is a major issue and ---you know you seriously don't understand what you should be doing it for…heaven's sake…everyone just wants to go home on Friday afternoon (general laughter in the group) …I mean it's your first year …you're not used to studying …now there doing all this stuff and then on a Fridays so I have to be honest that most people were incentivised and I've often sat back and thought it was a very poor way of doing it…but you've got no clue in your first years.' (FG3, Quote 37).* ***'****It was great fun in the residence (laughter in the group) because …um…I respected my bones but I had lots of friends that came into that room that just looked very carefully at this…it was real human bones (general murmurs of agreement in the group)…you know we needed to like…' (FG5, Quote 172).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				' I want to also mention that I think we have high hopes for our younger 22- year old selves to do all that and still be students. I don't think we should take it away I just think it could still be a hindrance to teaching is that you are 22 and most people are either looking to marry, or looking to Com Serve or looking to finish' (FG1, Quote 248).
	Learning techniques	Self-studying Ordered learning Use practical examples Learn by peer teaching Group work Go at your own pace It's basically up to you Tutorials with specimens Overview session Mock spot Dissection after theory just made sense Learning by doing Systemic approach Drawing in the prac book ' They drummed it into us' Used a ball to learn the muscles Learned by trying out certain processes on self I liked to just sit and look at the stuff I wanted to just sit back and read Plastinated models Different stations Learned off by heart but understood nothing.	6(21%) 3(11%) 2(7%) 2(7%) 2(7%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%)	***'…****I feel like it was a self-taught subject really. You went in and they kind of said… when you did dissection …it said okay dissect and we were kind of dissecting and we didn't really know what we were dissecting and it wasn't very specific' (FG4, Quote 11).* ***'*** *The theory was very rushed so that's why most of it was self study …um… they used to just say read this and this chapter from the textbook and go and do it at home…' (FG4, Quote 12)* *'In our anatomy dissection hall I thought there was quite ...er… a lot of… or enough specimens for us to look at so there would be …um…different stations… quite a few different stations and you would split up into groups and then you had the chance to…um…you know like…study guide with you and you would go through the questions and then look at the bones or muscles whatever and …and it was up to you to make the effort too or you could always sit and watch someone else but …' (FG2, Quote 89).* *' I found like the…when you had to like the practical the dissection I found that really helpful immediately after the theory because when you're going through the, the, the, the theory part at home or you're revising it or to me it made that personally to me…it made much more sense when I actually saw the muscle and I had that visual representation of the muscle so everything was just…just made sense…' (FG4, Quote 44).* *'For me it was definitely learning by doing…so you would…you would have to prepare. You'd read your prac manual, look at your atlas and then it was the hours that we spent. If you have followed the sciatic nerve from its origin to insertion without cutting it through (group laughs) ' (FG5, Quote 60).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				'Time spent and often with a colleague as well where we were working together slowly with our textbook at our own pace going through the model, looking at that, asking each other questions and I had the fortune of a friend who had a bad eye accident (group laughter) and missed a lot of lectures and had to be taught everything and I spent many hours with her at her house and in the prac labs helping her to catch up the work and the most that I remember is the stuff that I had to teach her' (FG5, Quote 62). *'I had a ball and I wrote each muscle down on a little piece of paper and I'd pull it out and see if I could say the four points about it. Pull out the next one randomly and I just remember doing that FOR HOURS' (FG5, Quote 67).* *' I learnt it off by heart. I could get full marks on it. I was too happy when they asked me but I understood nothing….' (FG4, Quote 154).*
	Student experience of course content, assessment, motivation and perception	Group dynamics/ Group dynamics Everybody just studies to pass Spot exams/ Spot exams I didn't like the teaching style Speed up the dissection process Anatomy is very intimidating Lectures very intense…in depth Memorisation not problem-solving Dissection not helpful Not prepared for dissection. Theory explained before cadaver observation Learn theory for exams CAN'T LEARN AN ENTIRE ARM IN A WEEK Summaries help Huge text book…Oh my word! Parrot learn to pass	5(6%) 5(6%) 5(6%) 2(3%) 2(3%) 2(3%) 1(1%) 1(!%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%) 1(1%)	*'I did not like learning the content off by heart (laughs) so it was never the subject I did best in because I think there was a lot of memorisation rather than problem solving' (FG5, Quote 33).* *'Also to have the theory explained before looking at the cadaver because going on and saying…this week we're doing the arm …go home and learn the entire arm …when you com you're going to dissect the whole arm (sarcastically) I'm sorry I CAN'T LEARN AN ENTIRE ARM IN ONE WEEK! (Murmurs of agreement from some group members) It's not going to happen so I go into the dissection and maybe I know like four or five muscles of the entire arm. So I go in and I look for those and it helps in terms of that but not the rest of the arm because there's no theory behind it '(Pause) (FG4, Quote 57).* *'And I think anatomy is very intimidating when you get a huge text -book and then you think Oh my word! How am I going to learn this? And then you start picking things that you think and then you parrot learn so you can pass. You're actually learning NOTHING…ABSOLUTELY NOTHING…'cos then next week if someone asks you…you won't know and you're just trying to*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
		Course presentation makes a big difference	1(1%)	*squeeze as much as you can into such a short period…' (FG4, Quote 60).*
		Muscle function important	1(1%)	
		Anatomy curriculum tailored to medical students	1(1%)	*'Ya but the other…the other thing that I pick up when we are studying anatomy especially dissection area …we are in groups so usually the one that know better in one group is the one that's handling everything there (murmurs of agreement from other group members)…but the rest is just standing there and just…you know talking whatever, chatting and something like that. The one that KNOW more is gonna LEARN more at that process and then the other one's just relaxing you know and saying okay he's cutting like this you know I need to cut this way and then what is this muscle and then divide away and that sort of group work to others I think…it's…it's a problem. …you know and because they are not grabbing everything at the same time' (FG4, Quote 33).*
		Oral exams/vivas	1(1%)	
		Appropriate exam content	1(1%)	*'…A lot of the time you actually learn the anatomy of structures. I know what the arm can do. I know what the leg can do but what does it apply to me and most of the time because it's…like we had it over the course of a year and over a year you had to cover theory and practical and the aim was always to pass…I need to know this, this and this to pass. Not I need to know this because one day it will assist me figuring things out as a physiotherapist but more I need to know this to pass' (FG4, Quote 46).*
				'I just wanted to say with that when you get to second year you start anatomy you don't actually know the magnitude of how much you need to know by your exam. You think ugh…I'm going to breeze through this…you'll be fine and then come your first test it's actually you need to know almost a quarter of your text book and you don't realise it until you need to study for your exam and I don't think it's emphasised enough in lectures or in practicals you need to know this (loud noise as phone drops to the floor) for like exam purposes whatever it is. And then like leading from the spot behind they don't stress that enough and I think that needs to be like put into like students' heads you need to know this by your exam …like don't waste time or…whatever it is only studying two weeks before that and in terms of spots even not enough practice time is given

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				before this. I mean yes the museum's open but then you have to struggle between your physiology and your other subjects and still make time to visit the museum. Rather have it as part of your dissection and then at least if you're familiar with the cadavers you can still have it for a minute …could be familiar with what was there before…um… whereas if you see this thing that's new now you have to figure out what it is where it comes from…um…so I think that familiarity with a lot of things will help in spot tests' (FG4, Quote 129). ***'** For me I think while I was doing that I often wondered why are we doing these things and we …but now that I look back it just makes sense to know anatomy so while I was in the situation I questioned a lot. … this bones of the skull for example but now that we are done with it it's almost as if it...it…it…maybe we don't have direct contact with the bones of the skull or any role with it that I think about but it does fill a small little piece of the puzzle in your clinical reasoning all these …you know where …that are holes in the …I mean we know here…here's a little 'gaatjie' something comes out' (murmurs of agreement from the group)(FG5, Quote 129).*
Inter-professional education	Between student disciplines	Occupational therapy (OT) students Physiotherapy students Dental students Nursing students Speech therapy students Medical students Dietetic students Pharmacy students Not specific to physio and chaotic Podiatry students We had theory with the OTs so I think it was nice to hear other voices Optometry students	20(95%) 20(95%) 9(43%) 8(38%) 4(19%) 4(19%) 2(10%) 2(10%) 2(10%) 1(5%) 1(5%) 1(5%) 1(5%)	*' We had OTs, nurses and physios and then when it came the dietetics came in our third module when we were doing the thorax and the digestive tract' (FG1, Quote 88).* ***'** We had…for dissection we had the OTs and ourselves and then for actual lectures itself and then you had that dentistry students would join and …and that of speech therapy and they would join you for your normal lectures.' (FG3, Quote 301).* ***'…**our lectures we had with the medical students, nursing students, the OTs …um…and it was us as well. And for practicals we were separated into our different disciplines' (FG5, Quote 104).* ***'**I think for me …um…we had theory with the OTs so I think it was nice to hear other voices than the ones we keep hearing in the same class every day' (FG5, Quote 98).* ***'**I think also with anatomy it was never shown as to how it applies*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				to us because we did it with OT, pharmacy, dentistry. It was never how does this help you as a physio' (FG4, Quote 46).
Student assessment	Positive assessment	Spot exams Term mark Draw diagrams in tests Marked for dissection skills Prac books assessed Promotion Motivation Only one written exam Go through all those steps' Practice spotter	5(33%) 2(13%) 1(7%) 1(7%) 1(7%) 1(7%) 1(7%) 1(7%) 1(7%) 1(7%)	***'** And we also had spot exams as well (murmurs of agreement from the group and one person says Oh ya!)… which were actually really great though… 'cos that helped me…it helped me a lot.(general agreement from the group)…Ya! That helped me a lot' (FG2, Quote 29).* ***'…**then we'd also have to draw diagrams sometimes in our tests which I thought was really helpful 'cos that makes you visualise it and label the diagrams' (Pause) (FG2, Quote 40).* *'I think the best thing for me was that if you got more than 60% for your year mark you didn't have to write the year…the end exam and it was so motivating…' (FG3, Quotes 146,148).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	Negative assessment	Asked something they told you to not worry about Buzzer goes …have to move on to next thing Move on/ move on No time to remember or think Need to be a clever person to catch the something at that time The amount of time is not right TIME is too little? Orientation It feels like five seconds Now I need to think while the clock is ticking Spots are not physio appropriate 30 seconds It's this massive guessing game Led down incorrect path Couldn't label…couldn't answer the next question. Long questions One minute stations	4(17%) 3(13%) 3(13%) 2(8%) 2(8%) 2(8%) 2(8%) 2(8%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%)	*'But when the tests come…they can (anticipatory murmurs from the group and one group member says " that's for sure") …that deep muscle they said don't worry about is there!'(General laughter from the group) (FG4, Quote 14).* *'And they always made the long questions like really difficult' (FG2, Quote 28).* *' (Referring to spot tests)…because we had like this one minute stations where you get like a minute with the flag to name it and I mean if you don't know you don't know and when that buzzer goes you have to move to the next thing …and you can't even remember to think okay maybe it could be this maybe it could be that if you've missed it you've missed it. You have to have such a good knowledge …' (FG4, Quote 58).*
	Order of alignment of content with assessment	Bad alignment Good alignment	1(50%) 1(50%)	*'…We got asked about the lower limb when we had only done the upper limb and I think it just gave everyone a really bad feeling about anatomy…' (FG2, Quote 20).* *'If we did upper limb we'd get tested on upper limb and then lower limb but we never… ' (FG2, Quote 21).*
	Timing of assessment	Theory exams Practical exam Spot tests Test every week Sectional tests/ Test on each section	4(22%) 3(17%) 3(17%) 2(11%) 2(11%)	*'…and also having the weekly tests so straight after dissection… or we wouldn't dissect…but straight after the practical where we saw the cadavers we'd then go write a test. So all students who'd re-done their work or you saw it all in the dissection lab and then you'd go write a test straight after that so it kept you up-to-date…um… with your study' (FG2, Quote 34).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
		End of the year	2(11%)	
		Test straight after seeing the cadavers	1(6%)	*' So halfway through the block we had multiple choice (someone coughs) and then at the end it was long questions' (FG2, Quote 27).*
		Long questions	1(6%)	
		Keep up-to-date	1(6%)	
		Multiple choice	1(6%)	*'And at the end of the year they could literally give you anything you learnt as what happened with my first…it was only in the first semester that I had to do that but, if you failed the first semester you'd go write again at the end of the year and then you really don't know what….you can get anything…' (FG2, Quote 39).*
		Practical stations	1(6%)	
				'It was a nice way because I think we only had one or two written…actually written papers that sort of two or three hour exam the rest of them were…I think it was smaller assessments and your spot test and your spot test Is practical …'(FG3, Quote 119).
Ethical considerations	Ethics and sensitization	Respect	4(13%)	*' When we started with anatomy (Pause) the first lecture I remember it very vividly. There was a cadaver on a table with a cloth over and the whole lecture was just to get everyone desensitized and comfortable and it was very respectable. I remember it now still so I think that definitely helped and that was good (Pause) not necessarily I don't think I would have more respect or less respect because I worked with wet specimens instead of the whole cadaver.mm…mm…I don't know if that would have made a difference. But in the beginning it was very respectful and nice and they did try to implement the fact that… It was always stated that you were working with people. It's not something you can throw around and not …that type of thing" (FG1, Quote 62).*
		Dedication service	3(9%)	
		Someone's family member	2(6%)	
		Dress code	2(6%)	
		Don't know what to expect	2(6%)	
		Introduction	2(6%)	
		It's a big privilege	1(3%)	
		Desensitisation	1(3%)	
		I felt that they handled it very well	1(3%)	
		Open the whole body	1(3%)	
		Taken very seriously	1(3%)	
		Given a history	1(3%)	*'So like I remember being apprehensive going into the first… the first one 'because you don't know what to expect but I felt that they handled it very well 'cos they did like a whole service. They made us open the whole body …look at it so that like you couldn't imagine things you knew exactly what was lying there and after that it was fine' (FG3, Quote 95).*
		There's not a lot of respect for cadavers	1(3%)	
		It's an actual person …at the end of the day this person…donated their body so that we could learn.	1(3%)	*'I think it was very well handled your introduction and it was quite a solemn…um…event…the initial dedication of the cadavers and whatever ' (FG5, Quote 113).*
		Concept of ethical biography	1(3%)	
		Not allowed to take pictures	1(3%)	
		Got into trouble for taking a picture of a cadaver	1(3%)	*' We were introduced and you were given a history and…um…you*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
		Emotional preparation Let us do it properly because people really do make a mess of things	1(3%) 1(3%)	*know a briefing about the patient and that they either donated or they were unclaimed status ' (FG5, Quote125).* ***'**I think this even also there's not a lot of respect for cadavers (murmurs of general agreement from the group) so that's why I feel like when there's stress in dissection let us do it properly because people really do make a mess of things (unknown group member agrees) and dissection is taken very lightly but it's an actual person so I think that's what needs to be emphasised and even through the dissection process there has to be properly because at the end of the day this person…whatever…donated their body so that we could learn. So I think that's where that needs to come in it's just like some form respect …a body's been put forward here' **(**FG4**,** Quote 194).* ***'**But I think also as an addition I think it would be like …it would be ni…it would be…it would make much more sense if they would just brush through the ethical biography. Like explain that you're not allowed to take pictures. Know that you might be seeing this show. So at least they are preparing emotionally so that when we get there we know exactly what to expect also what not and what to do. So we nev …never got that because one of my friends was actually in trouble for taking a picture of a ca…ca…cadaver. We didn't know that we shouldn't take pictures you know so just I think also as…as…as an addition they should just brush through even if they're not going into nitty gritty details but just brushing through the ethical component of what we should do what we shouldn't do what must …what we going to expect…um… in the dissection room' (FG4, Quote 196).* ***'**I think they were more strict with us with that …um…like you weren't allowed to enter without a lab coat on. You weren't allowed to sit in that dissection hall without a lab coat. Like if a phone was seen it was unacceptable. You know you were always supposed to have your student card showing so that they knew you were allowed to be there. So with us they made it very clear and even in…we had dedication ceremony before we started and when we finished and the whole idea like was in it was they kept*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				reiterating…You must remember this is somebody's husband or wife, chi…like daughter, son, mother, father. This is a human being and have respect for that so they were very good with us with laying that down …making sure we WERE aware of it' (FG4, Quote 197).
	Cultural and/or religious considerations	Mainly boys Blocking screens Head scarfs Muslim Suitably undressed	1(20%) 1(20%) 1(20%) 1(20%) 1(20%)	***'**Well it was volunteer-based and usually the boys would …Like if you had to get suitably undressed you did it. Our class you know…you asked the class…the class was asked if it was okay. If someone had a problem with it then they were welcome to leave or study it by themselves but no one ever had a problem with it and it was always the boys that actually that did it' (FG2, Quote 170).* ***'**We had a couple of girls…um…Muslim… who didn't want to. Some of them took off their head scarfs and that's as far as they went…they wouldn't undress and…' (FG2, Quote 171).* *'But was that after the first year? Like after first year people got more comfortable and also they gave us those screens**.** So if you wanted to go behind that you could' (FG2, Quote 172).*

Within Theme 4: ‘Student Embodiment’ in Anatomy the most frequently recorded codes relate to the category of inter-professional education between student disciplines. It can clearly be seen that in the majority of cases PT and OT students work together (n=20, 95%). Other students share facilities, materials and/ or anatomy instruction with PT students to quite a large extent are dental students (n=9, 43%) and nursing students (n=8, 38%).

‘Lack of maturity’ as in lack of lack of a serious attitude (n=6, 33%) in students’ learning anatomy was noted.

In regard to the sub-category ‘learning techniques ‘the most frequent code was ‘self-studying ‘(n=6, 21%). This code was delivered with what could be perceived from the quotes as an element of frustration, disappointment and even anger by participants. Furthermore, participants felt that the onus to learn was firmly on their shoulders. Some of the participants preferred ‘learning by doing’ (n=1,4%). ‘Peer teaching’ (n=2, 7%) was found to be a successful learning technique bu one participant. However, another participant preferred self-teaching to peer teaching.

A popular code in the student assessment category was positive for ‘spot exams’ (n=5, 33%) where participants enjoyed the experience. Codes such as ‘No time to remember or think’, ‘The amount of time is not right’, ‘TIME is too little’ were each mentioned by n=2 (8%) and ‘It feels like five seconds’ and ‘Now I need to think while the clock is ticking’ were mentioned n=1 (4%) times. These codes expressed negative viewpoints on the use of spot examinations. Students found that ‘promotion’ (n=2, 13%) was a motivating factor to try and achieve the 60% threshold for the course mark to achieve exemption from the final examination. The ‘timing of assessment’ sub-category revealed that ‘sectional tests’ in either the ‘written’ (n=4, 22%),’practical’ (n=3, 17%) or ‘multiple choice’ (n=1, 6%) question formats were spread throughout course structure and ‘final exams’ (n=2, 11%) were held at the end of the course.

Learning by ‘using practical examples’ (n=3, 11%) was appreciated. An important but infrequent code identified in this sub-category was that of ‘Learning off by heart but understanding nothing’ (n-1, 4%).

Students are required to develop an understanding of the ‘ethical considerations’ of the anatomy course and certain aspects of the way in which ‘sensitization’ factors are handled also falls under this overall category. Participants described first encounters with a cadaver

and how it was handled and in particular two participants described their ‘introduction’ to the cadaver. Particpants told how some students appeared to have little knowledge of ethical matters and used cell phones to take pictures of cadavers. Other particpants had a stricter anatomy experience with a dress code and defined ethical boundaries.

Students in anatomy programmes come from diverse cultural and religious backgrounds. These factors have to be considered in particular with the use of surface/living anatomy techniques. In this case five codes were equally identified (n=1, 20%). One of these related to the fact that mainly male members of a class would undress for surface anatomy. A participant noted that as the PT course progressed students were more comfortable with undressing in front of each other especially as they could do the class behind a privacy screen.

Overall Theme 4: ‘Student Embodiment’ in Anatomy had many components and illustrated the large number of factors influencing the way the students, learnt anatomy, interacted with each other, reacted to assessment and were made aware of ethical considerations in preparation for their future PT career.

Selective Coding for Theme 5: Gross Anatomy Classes

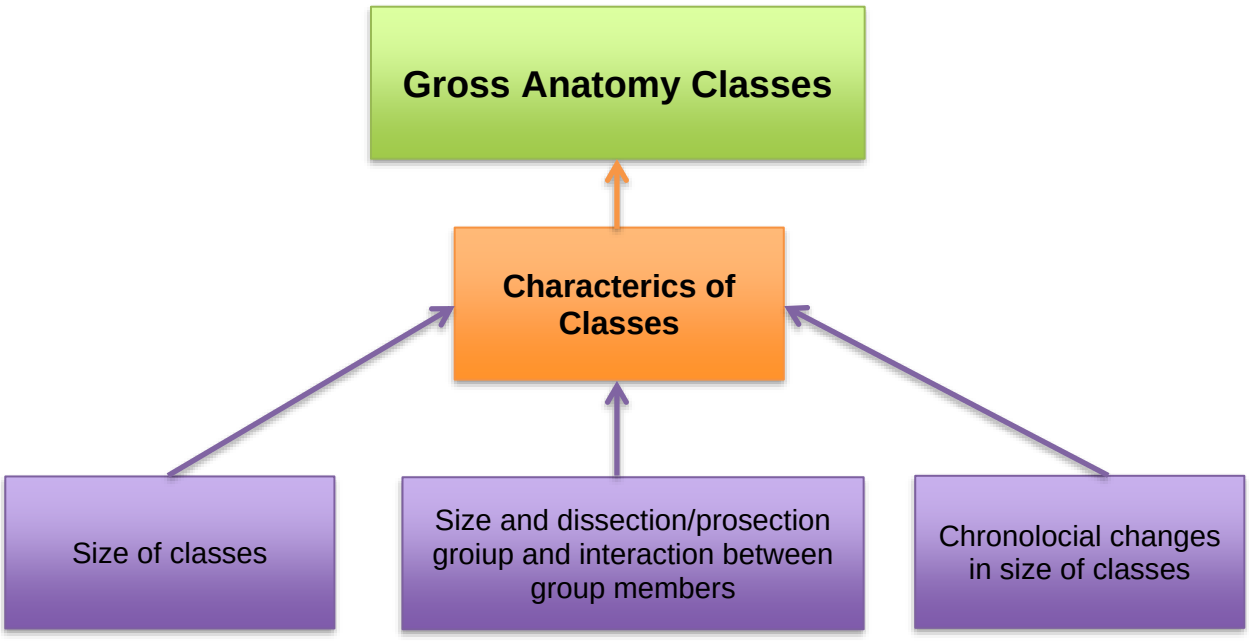

Figure 5.6: Schematic of Theme 5: Gross Anatomy Classes, Category and Sub-Categories

Table 5.10: Theme 5: Gross Anatomy Classes

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Characteristics of classes	Size of classes	Actual class size 'Was too big' Better if they were smaller Quite a big class 'Pretty small ' Smaller group Tutorials smaller	4(44%) 3(33%) 1(11%) 1(11%) 1(11%) 1(11%) 1(11%)	***'…****then there were also tutorials… and those were smaller groups maybe fifteen, twenty people…in dissections as well we were a group of six to eight people…'(FG5, Quotes 9, 11).* ***'But I also think that given the tut classes …that are in the labs down there in the underground (giggling from group)…em…it was too big…like the anatomy classes were too big…and I really, really battled to hear the demonstrator or the tutor and I would always have to sit on top of them so I could hear what they were saying (group laughter)…' (FG2, Quote 61).*** *'We just had OTs and physios and I thought it was a pretty small class. It was good '(FG2, Quote 86).*
	Chronological changes in size of class	Class of forty to fifty Groups are going to be a lot bigger Groups weren't as big Not practical to learn You get a lot of attention in a small group	1(14%) 1(14%) 1(14%) 1(14%) 1(14%)	*'like a class of like forty to fifty …if I think back now…and the groups weren't as big…' (FG4, Quote 40).* ***'If we're on the actual class size. I mean when I did physio I was one of 29. Now the physio class is like 60-70. So I mean the classes…the groups are going to be a lot bigger '(FG3, Quote 315).*** ***'…*** *So by the time we got into second year we were 72 physios ONLY that didn't include OTs, pharmacy…nurs…it was crazy! ' (FG3, Quote 324).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
	Size of dissection/prosection group and interaction between group members	Six people per cadaver Group of six to eight people Two people per cadaver Ten in a group One in group handles everything Rest just stand around Something to see on different tables. It was a very intensive thing and it worked Last person would have to put everything away at the end of the session No getting away from doing it and doing it properly Had to rotate responsibilities Two would sort of direct what had to be done from the book and four of us would cut	7(27%) 4(15%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%)	***'*** *Ya but the other…the other thing that I pick up when we are studying anatomy especially dissection area …we are in groups so usually the one that know better in one group is the one that's handling everything there (murmurs of agreement from other group members)…but the rest is just standing there and just…you know talking whatever, chatting and something like that. The one that KNOW more is gonna LEARN more at that process and then the other one's just relaxing you know and saying okay he's cutting like this you know I need to cut this way and then what is this muscle and then divide away and that sort of group work to others I think…it's…it's a problem. …you know and because they are not grabbing everything at the same time ' (FG4, Quote 33).* ***'…****We dissected in groups of five by ourselves' (FG3, Quote 13).* ***'…*** *You'd go from cadaver. I don't know I think ten in a group…' (FG5, Quote 23).* ***'****And I think of everyone I'm the only one who had two rather than six, or eight, or ten…for me that was…um…I would think that we were at a huge advantage 'cos there was no getting away from doing it and doing it properly so if you were dissecting upper limbs each took one and it was only really…sort of middle that we had to share and take turns. So one person would read and the other person would dissect. So it was a very intensive thing and it worked well for me because of the partner I had. I think if you ended up with a dud partner it would have been a bit*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				more challenging' (FG5, Quote 102). ***'**During practicals …um…we were about six I think with one cadaver….the same thing we always had a nice mixture of folks who liked to take over …those who want to cheerful …so I think it was a nice experience because you .. there's always something happening everyday something to see on different tables' (FG5, Quote 98).* ***'**The practicals we also had six in a group but we had to rotate responsibilities so one day you'd have one person dissects, one read, one go through the functions and all of that and then the last person would have to put everything away at the end of the session …um…which we found really helpful because when each of us had to participate in it…um…ya. And for practicals we were separated into our different disciplines but …um…we were allowed to mix especially for tests and things like that' (FG5, Quote 104).* ***'…**that were around a body you…so you were able to actually do the stuff and if not still be part of the group and sit there and guys I'm reading from the anatomy book and this is this is what you kinda need to do and someone else would do it but if your part …now if the student don't have cadavers…their looking around it… about ten or twelve around this body what can you see from the bottom about the dissection?' (FG3, Quote 320).*

Theme 5: Gross Anatomy Classes highlighted the chronological changes that have occurred in overall class sizes. This has also resulted in changes to the size of dissection/prosection groups and tutorial groups and such changes have impacted on aspects of gross anatomy teaching.

In the category 'Characteristics of classes' it was very apparent that in the sub-category 'size of classes' the most frequent code was actual 'class sizes' (n=4, 44%) with class size described as 'was too big' (n=3, 33%) in the majority of cases. Large class sizes were associated with difficulty to hear the instructor and difficulty with dissection in larger groups. It was clear that over the years there had been a gradual chronological increase in class size

The size of dissection/prosection groups varied but the most frequent code identified was 'six people per cadaver' (n=7, 27%). This was followed by 'five to six per cadaver '(n=4, 15%) with 'six to eight', 'ten in a group' and 'two in a group' all (n=1, 4%). It was noted that the group dynamics in such groups differed and in some groups one person took charge or sometimes group members were happy to let someone else do the dissection for varying reasons. One participant reported on an ordered rotation of duties in the dissection process.

Selective Coding for Theme 6: 'Time is of the Essence'

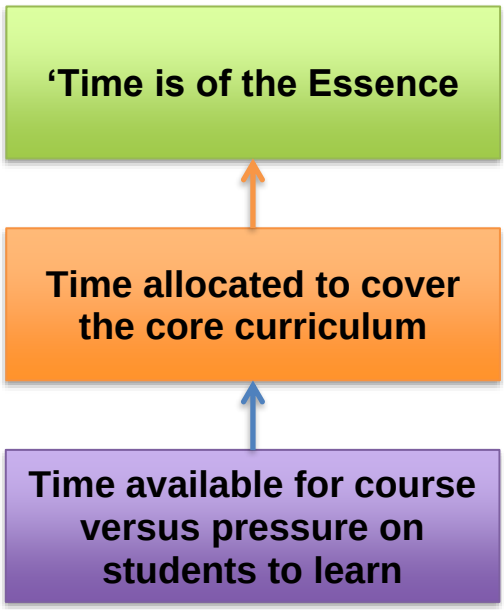

Figure 5.7: Schematic of Theme 6: 'Time is of the Essence', Category and Sub-Category

Table 5.11: Theme 6: 'Time is of the Essence'

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Time allocated to cover the course curriculum	Time available for course versus pressure on students to learn	PRESSURE TOO MUCH anatomy Second year RUSH Heavy on independent study time Computer labs or library for access but if you don't have the time for that then …then it's a problem. No high speed Wi Fi Three hours of anatomy lectures just once a week…used to kill us Just trying to keep up I CAN'T LEARN AN ENTIRE ARM IN ONE WEEK! Pre-dissection assignment Squeeze into a short period The TIME limit you get to prepare TIME Manageable but not fruitful Long tedious lectures	3(10%) 3(10%) 3(10%) 2(7%) 2(7%) 2(7%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%)	'It was much of theory to us and then, at the same time, they were diverting it to be like practical wise… they tried to push us to understand anatomy '(FG4, Quote 14). '…Very long, tedious with lots of information lectures…that I used to fall asleep in ' (FG5, Quote 20). 'Anatomy it was …probably still is …very heavy on…um…your independent study hours so your lecture would be…I wouldn't learn anything in the lecture to…to remember it would be an overview of…okay so now I need to go and do this and this and this and the only things I'd really remember from a lecture would be if they gave a pneumonic, some trick to learn something…um…but the actual retention would be hours and hours and I remember sitting with the muscles…the list of the muscles' origin, insertion and innervation…and function ' (some laughter in group) (FG5, Quote 67). 'I think ours was very structured and I can't think…but we also had a booklet of dissection so before every dissection you actually had to complete a whole (Pause) assignment I guess but it took forever so I don't know how many of it we actually got through. But Ya, that's the idea…' (FG1, Quote 108). 'Our tutorials had the … were optional but then the time limit you get to prepare to go through the work and see what you actually are not understanding (murmurs of agreement within the group) is also difficult ' (FG2, Quote 116). 'I CAN'T LEARN AN ENTIRE ARM IN ONE WEEK! (Murmurs of agreement from some group members) It's not going to happen' (FG3, Quote 57). '…You're just trying to squeeze as much as you can into such a short period…' (FG4, Quote 60). 'So everything was just bombarded into second year' (FG2, Quote 181). 'We had access to the big computer labs …um…in (names the university) …so it was available all to us but the problem was the whole

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				of (names university)…has access to that as well so it was about finding time and then you'd just get so much else to get done in second year because it's a big year with anatomy and physiology and physio that to just… to find time to go and sit down at the computer as well and do additional stuff there when we want to go and look at the specimens that are placed out in front of you for spot test and all that stuff and anything else you want to do …time is a problem"' (FG3, Quote 254). 'I…I felt it was too much content for that time. Like it was manageable in terms of getting there…writing your exam and passing it eventually but I didn't feel I learnt adequately in second year it all made sense later down the line because it was just too much content for one year. For me it felt like that '(FG5, Quote 147).

Theme 6: 'Time is of the Essence' presents a synopsis of aspects of anatomy courses and the perceived pressure due to time constraints experienced by students. In the early part of a course among the top ranked sub-categories was 'PRESSURE' (n=3, 10%) *and 'I CAN'T LEARN AN ENTIRE ARM IN ONE WEEK!' '*TOO MUCH anatomy' (n=3, 10%) was another top category. A direct reference to time was made in the code 'TIME' (n=1, 3%).

Selective Coding for Theme 7: 'Anatomy Know How' for Physiotherapy Practice

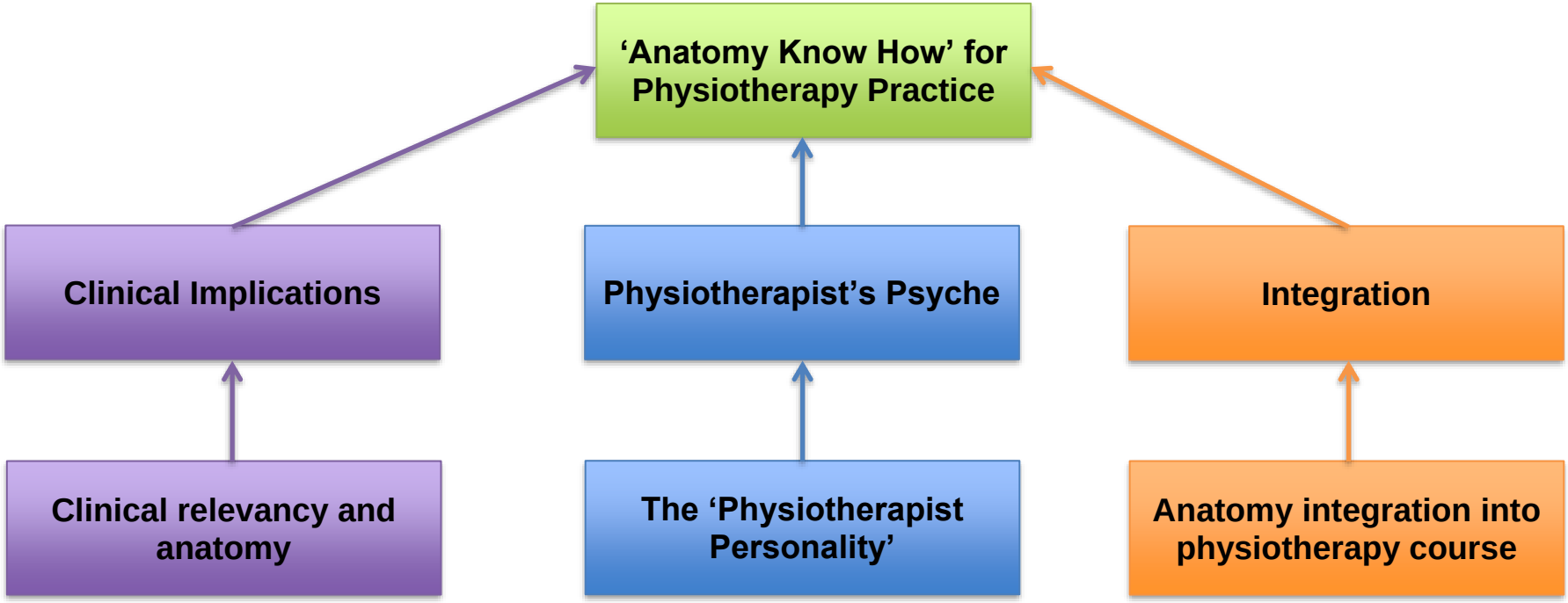

Figure 5.8: Schematic of Theme 7: 'Anatomy Know How' for Physiotherapy Practice, Category and Sub-Category

Table 5.12: Theme 7: 'Anatomy Know How' for Physiotherapy Practice

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Clinical implications	Clinical relevance of anatomy in physiotherapy practice	Physio diversity Anatomy and clinical work Four years not enough Vertical integration Revisit dissection Fascia Detail Revisit anatomy during clinical rotations Well integrated Layman's terms Manual labourers Clinical relevance of anatomy Anatomy and clinical reasoning Muscles don't happen in isolation Piece of the puzzle Scraped Multifidus away First line practitioner Employer perspective Learn all in one year Physical touching/feeling	6(24%) 5(20%) 4(16%) 4(16%) 3(12%) 2(8%) 2(8%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%) 1(4%)	*'It was only when we started doing clinical work in third and fourth year that…you actually sort of realised the relevance of it' (FG3, Quote 40).* *'We start going to clinicals from second year …second semester so we start quite early…I can see patients and see injuries although we're just doing …sort of just subjective assessments but also you're hearing things that he brings up …stick. Only then did I start to appreciate it' (FG3, Quote 45).* *'I think that…muscles don't happen in isolation so I'm…I'm really glad and I feel really privileged that I got to do the dissection and get the anatomy that I did. I don't remember everything all the time but I can go straight back and…and find it and I think it was very important to do…slow down and spend some time on really getting an idea of the whole human body…' (FG6, Quote 132).* *'"So I felt they were giving us too much sometimes but if …when I mean when you start practising then you see that it's never too much information …literally need all of this' (FG5, Quote 143).* *' I mean, even though you live in South Africa, the fact that you're… a first line practitioner if you for instance leave out the GIT or anything then you're taking away you know so then you can basically just pick up or diagnose musculoskeletal stuff and not that you can diagnose GIT but you must be able to pick up something that's…' (FG1, Quote 192).* *' I think that you need to apply it and that your physical touching, feeling. We're manual labourers really. Use our hands. We have to feel. We have to, I mean how much of our assessments and everything are done looking and feeling?' (FG1, Quote 265).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
Integration	Anatomy integration into physiotherapy course	Surface anatomy Biomechanics Time Brief revision course of anatomy Link anatomy to physio Refresher Integration Doing neuro in third year… Fitting together Functional /Applied anatomy Gym practicals Muscle fibre directions Lecturer pro anatomy Quick (surface anatomy) No time for physio lecturers teaching sport's physio to revise anatomy of a joint. Physio techniques require knowledge of muscle fibre direction for easier application Can't dissect patients. Must tie anatomy to clinical cases. When you start practising then you see that it's never too much information	15(44%) 10(29%) 8(24%) 3(9%) 3(9%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%) 1(3%)	*'What happened with us was that we did anatomy…all anatomy at first year so by the time we got to second year when you did biomechanics and stuff you'd have to make that link so I feel like it worked…' (FG2, Quote 37).* *'…Now I'd rather go do a dissection in my third year or my fourth year once I'd actually done the theory and be able to look at it and be okay so when I work here this is what I'm working on and actually imagine it in that way' (FG4, Quote 37).* *'Ya… if you say doing neuro now in like third year or whatever then to revise the brain and like know exactly how that works' (FG4, Quote 51).* *'In our…er…we called them gym…gym practicals…so it's more like testing on specific techniques that we did in second and third year …er…we were tested on anatomy in that as well. So if you had to do something that… say a technique to strengthen a p…a glut med you'd have to give the anatomy of that muscle as well which also helped revise anatomy 'cos I don't think I would have learnt or revised it as clearly if we weren't tested on it in those small practicals…' (FG2, Quote 59).* *'Even pre-clins…I mean that's a whole different topic but you sit there and you've got no idea what they're teaching you. You've never seen a patient with a spinal cord injury so they teach you all this theory….like everything as a parrot. Until you work with a paraplegic patient your like…you don't know anything. And the same like it goes for anatomy. Like they can teach you all of it and you look at …and you go okay and it sort of makes sense but you can't picture it until you've seen it and until you've sort of handled it and worked with it so maybe as an additional thing… I know physio is hectic as it is but to include like anatomy in like your later years…once you've had some experience …even if it's a little experience …a little exposure… I mean we would love to do it now 'cos we've all been working for some time …a but even if it's part of like…um…clinicals you know. Just a little bit of anatomy here and there. I really think it would be helpful ' (FG4, Quote 70).*

Category	Sub-category	Codes/keywords	Code frequency n (%)	Quotes to illustrate
				'The other day I was working with a quadriplegic patient of mine and his first rib was really, really sensitive. He was complaining of a lot of cervical pain and that sort of thing and he said 'What are you doing?' and I said ' I'm…I'm mobilising your first rib' ' My first rib? It's not there' (Laughter in the group) And I rushed off to get my anatomy book and I show him where it is and 'Oh!' ' You know but it's that sort of thing I mean you need to know those, those sort of, where to find the first rib and where to you know and what are all the …so I think …yea …it's a very good thing I did surface anatomy' (FG1, Quote 219). ***'**Ya I agree. In the end the patient's' we're working on are living. We can't dissect them to see what's going on inside. We need to be able to identify the landmarks so I mean…I also…I think we did it one …um…ya we did one lecture on surface anatomy (someone in group giggles) per section' (FG3, Quote 259).*
Physiotherapist's Psyche	The 'Physiotherapy Personality'	Strong Lists We do well with someone telling you this is where it is. This is what it feels like. We're structured people	3(30%) 2(20%) 1(10%) 1(10%)	*'I think…um…especially with like physios we tend to …or not to (sighs) .I generalise but I think we tend to be like…our personalities are very like…we're structured people. We like lists and this and that and show me what to do and how to do it and I can do it. You know…um…so also with anatomy…show me and…you know…and I'll be able to do it but don't sit there and lecture me and you know …this and that and here and there…it should be like this. We're doing the arm now…okay great …like this and then you go and look at the arm and we can sort of tick our lists (murmurs of agreement from the group) like that's what I think will explain…' (FG4, Quote 45).* ***'**I…I think once again and it's a very like generalising again but I think physios are quite like …they're quite strong…' (FG4, Quote 180).*

Theme 7: ‘Anatomy Know How’ for Physiotherapy Practice embodied aspects of PT practice that were linked to the way in which anatomy was learned and gave an indication of what the participants had found helpful during their anatomy experience but also what they believed would have improved their anatomy experience. In the ‘Anatomy integration into the PT course ‘sub-category ‘surface anatomy’ was the most frequently identified code (n=15, 44%). The second most frequently identified code also fell within this sub-category and was ‘biomechanics’ (n=10, 29%). A participant gave insight into the timing of the sequence of biomechanical practicals and their relationship to her anatomy course.

One participant really linked the usefulness of learning surface anatomy to helping a patient understand where their pain was coming from. The importance of surface anatomy also was illustrated in the code ‘manual labourers’ (n=1, 4.

In the sub-category ‘Clinical relevance of anatomy’ the code ‘physio diversity’ occurred most frequently (n=6, 24%). This code developed out of the fact that PT has many specialities today and mention was made of such specialities and the fact that the anatomy course has to perhaps cater for every eventuality. A desire to ‘revisit dissection’ (n=2, 8%) was expressed in regard to a vertical integration scenario.

The feeling of too much information was addressed. The first line practitioner status of a physiotherapist in South Africa was raised in connection with the clinical need to have adequate general anatomical knowledge to cope with that responsibility.

A participant did feel that the course was ‘*well integrated’* and the code ‘Vertical integration’ (n=3,12%) was supported. A good case for pre clinical integration was made.

Finally, it appears that there is the ‘Physiotherapy personality’ and physiotherapists are ‘strong’ (n=3, 30%) and like to make ‘lists’ (n=2, 20%).

5.1.17 **Discussion**

This discussion aims to contextualise the results formulated in the field of factors that may influence the gross anatomy curriculum and pedagogy adopted for South African undergraduate PT students in South Africa. The five FG discussion groups were conducted between 26 September 2016 and 11 May 2017 until theoretical saturation was attained.

Over the course of the FGs as participants were added it became clear that representation of gross anatomy education for PT students in all eight of the Health Science Faculties in South Africa was achieved. Furthermore the targeted service delivery sectors were adequately represented. A great deal of information was gathered by means of these FGs. Some of the codes generated did not pertain to the more secular or perhaps expected viewpoint on this topic and it soon became apparent that subcategories such as the 'Impact of dissection on the student psyche' and the identification of 'The physiotherapist personality' would add new dimensions to this research. The discussion will begin with an overview of the demographical information pertaining to the participants and then will continue with a discussion of the results relative to the objectives of the study.

5.1.18 **Overview of Demographic Factors**

5.1.18.1 **Age of participants**

The demographic data showed that the sample on the whole would give a perspective on what younger physiotherapists with a few years of experience felt about the discussion topic. This was beneficial to the outcomes of the study as this type of practitioner would have been exposed to the gross anatomy education system in South Africa in the last few years and therefore would be able to assess how appropriate that gross anatomy curriculum and pedagogy was to clinical practice needs in service delivery sectors at the present time. However, this is not to say that the opinions of the older physiotherapists were not to be valued as their contributions added to the depth of the research and were very useful for such historical comparisons of data as that pertaining to 'Chronological changes in size of classes'. It was also noted that the youngest participants mainly participated in the public sector groups and were functioning in the provincial public hospitals.

5.1.18.2 **Size of FGs, number of FGs in each service delivery sector and the overall number of participants**

The size of the FGs in relation to the number of participants, with the exception of FG1, were all within the parameters of six to ten suggested by Patton and Cochran (2002) and six to twelve as suggested by Morgan (1996). Focus group 1 was scheduled to have six participants but one had to pullout of the discussion at the last moment due to unexpected work commitments. The sample size over all the groups was thirty-two. In their literature review of qualitative studies Carlsen and Glenton (2011) noted that most of those studies recommended that the number of FGs should determine the sample size in this type of research and not the overall number of

participants. However, they also pointed out that the two factors of sample size are intrinsically linked to each other. In this regard, Sandelowski (1995) put forward that sample size is important but only in relation to whether the sample is insufficient to prevent attainment of 'saturation' or too large to be analysed in the deep and methodical way that qualitative research demands. They also argued that sample size should fulfill the purpose for which it was intended with regard to answering research objectives, provide adequate facilitation of research design and provide accurately measured outcomes. This study collected much valuable data that provided a deep and informed perspective on the topic but was not too large for successful analysis and reporting of its findings.

5.1.18.3 **Professional years of experience of participating physiotherapists**

The professional years of experience that the physiotherapists in the FGs had was commensurate with age and also it was noted that private sector physiotherapists and academic physiotherapists had the most work experience. This result for the public sector would be in line with the fact that the majority of the participants were either doing their community service year or were in the second year of their clinical practice.

5.1.18.4 **Gender factors**

The majority of the physiotherapists in the FGs, whether in the public, private or academic sectors were female. This relates well to the previously reported statistics of the WCPT (2017) as presented in Chapter 2, Table 2.1 of this thesis where the ratio of male to female physiotherapists in South Africa was reported as 1:10. This study found that the ratio of male to female physiotherapists was least in the public sector (1:6) and most in the academic sector (1:2.5). However, all ratios were less than that reported by the WCPT in 2017. This is possibly due to the fact that participants were not chosen because of gender or age and participation was random. This study found that the ratio of male to female participants in the private sector was 1:4.5 while the results of a survey of Canadian physiotherapists from the Quebec Province working in the private sector found a ratio of 1:1.7 and the WCPT (2017) statistics for Canada had it at 1:2.6 (Perreault et al., 2014). Although both these studies applied to provincial statistics the Canadian study had a much larger sample size. However, an interesting feature of the two results is that in both the provincial ratio is just under half of the overall ratio for the respective country.

5.1.18.5 **Physiotherapy qualification**

A distinct pattern for the distribution of level of qualification was seen across the three service delivery sectors. Due to the fact that all public sector group participants were newly qualified physiotherapists this sector only had physiotherapists with bachelor degrees (n=14, 100%). The private sector had an almost even distribution of bachelor (n=6, 55%) and masters degrees (n=5, 46%). An almost even distribution of qualifications with bachelors (n=2, 29%), masters (n=3, 43%) and doctorates 2(29%) was seen in the academic sphere. This mirrors the breakdown of qualifications in the Perreault et al. (2014) Canadian study where they found that in the private sector the majority of the survey respondents had a bachelors degree (n=189, 80%) and the rest had masters degrees (n= 23, 10%). However, the South African scenario seems to suggest that more physiotherapists in private practice attained a master's degree than was the case with similar private practitioners in Canada. The American situation is different in that the American Physical Therapy Association (APTA) (2011) has speculated as to **'**Whether the master's or doctorate would better prepare entry-level practitioners to meet contemporary and future health care needs of society'. In connection with this consideration APTA in 2000 passed 'Vision 2020', which suggested that 'By 2020, physical therapy will be provided by physical therapists who are doctors of physical therapy.' They included that by 2010 96.7% of physical therapy programmes (n=206) in the USA offered the DPT degree already. Other countries have also adopted this entry level degree programme but South Africa has not. The bachelors degree offered in this country is equivalent to an honours degree but students with the degree are not permitted to stipulate the term (Hons) after their degree (HPCSA, 2017). The highest PT qualification that can be obtained in South Africa is a Doctor of Philosophy (PhD).

5.1.18.6 **Clinical areas that physiotherapists in each service delivery sector work or teach**

Six clinical areas were identified where the FG participants were either working or teaching at the time that the FGs were held. The public sector FG participants served in five of the six clinical areas identified and it was seen that neuromuscular – skeletal, paediatrics and adult neurology were equally subscribed (36%) but cardiopulmonary was poorly represented in this sector. The nature of the public sector work is related to hospital service and therefore it is expected that many physiotherapy areas of expertise would be utilised in such a scenario.The private sector was highly disposed towards the neuromuscular-skeletal and orthopaedic specialities (64%) and this is in line with the statement that the private sector is often central in offering PT services for persons presenting with musculoskeletal conditions

(Perreault et al., 2014). Paediatric (n=5, 45%) and cardiopulmonary (n=4, 36%) were also areas with higher paticIpation in the private sector. However, involvement in adult neurology was poor in the private sector. It does appear that in developing countries such patients will be treated in the public sector (Deresse and Shaweno, 2015; Brainin, Teuschl and Kalra, 2007). The majority of the academic FG participants (n=3, 43%) taught in the neuromuscular-skeletal area. There was one new category introduced in this FG and that was in the area of community health. This inclusion was important as in South Africa within the poorer areas both in the urban and rural setting there is a need for PT to address the specific needs of the community at 'grass roots level'.

5.1.18.7 **Linking the identified themes to the objectives of the study**

The elements of a student's journey from the 'Bare Bones' of Anatomy to interaction with human cadavers and beyond into clinical application of anatomical knowledge are encompassed in a gross anatomy curriculum. The journey is guided by pedagogy used in teaching, the teachers themselves, students who learn and the doners whose selfless gift of their body provides the greatest teacher of all. The anatomy programme takes students on the afore-mentioned journey and the intention of the course is to help the students' aquire the necessary anatomical knowledge for their chosen profession but also to develop professional acumen and become ethical, caring and competent clinical practitioners. The amount of anatomical knowledge to be learnt is substantial and while it is the intention of this section of the thesis to discuss the results identified from the FGs pertaining to pedagogy, course content and curricular matters there will be discussion regarding the student's psychological response to such a course and possible impacts of that on the learning experience and curricular design and pedagogy chosen.

5.1.19 **Theme 1: The 'Bare Bones' of Anatomy**

5.1.19.1**'Bare bones': the skeleton**

The 'bare bones' (Theme 1) in one sense describe the skeleton of the human frame. In the literal sense students are given a bag of bones. One participant recalled how having access to this learning tool was really beneficial for visualising the correct anatomical location of muscles and other structures.

'We were given a skeleton to take home… The box ….the skull and that was invaluable. The hours I spent with that skeleton under my desk for a year was fantastic. And that was fantastic to see a tubercle and that you couldn't get looking necessarily always in a textbook or on an atlas or anything you needed to actually

see the…the ridges to understand where the muscle attached' (FG5, Quotes 169,171, 173).

In one FG the personification of the skeleton added a lighthearted moment to the proceedings:

'Oh James! (Group laughter and unintelligible chitchat)…It's a skeleton. So they used to put it in front of the class' (FG 1, Quotes 76, 78).

However, the procedure of taking an unarticulated skeleton to a place of residence related to the maturity and responsibility aspect of a student's psyche (Theme 4). This fact is illustrated in the way the bones were handled in the example below:

'It was great fun in the residence (laughter in the group) because …um…I respected my bones but I had lots of friends that came into that room that just looked very carefully at this…' (FG5, Quote 172).

The habit of allowing a student to remove the box of bones from the health sciences faculty has been curtailed in South Africa according to restrictions cited in Chapter 8 of the National Health Act No 61 of 2003 (Pepper, 2014).

5.1.19.2 **'Bare bones': defining type of curricular approach**

The regional anatomical approach divides the body into major regions such as the head and neck, limbs, thorax and perineum (Pais and Moxham, 2013). As previously mentioned the skeleton was the basis for learning muscular attachments. A participant linked this fact to a preference for anatomy to be taught with a regional approach:

…'I don't know …I just prefer learning it all together because then you learn where the muscle attaches on the bone and that's how you learn the bone otherwise your learning all the things of the bone but it doesn't…it's not really relevant to you like learning the greater trochanter…cool…I know where it is but I don't know what attaches and even if I learn what attaches I don't know what that muscle is. That's why for me I think it's better to learn it in sections like together with the muscles and nerves and everything. 'Cos then you know what nerve, where it runs through like and a lot of it makes sense ' (FG2, Quote 150).

But a participant in the public sector described learning anatomy using the systemic approach:

'So we would learn ALL the bones in one week, ALL the muscles and then ALL the nerves and ALL the blood vessels and we were taught that way…'(FG4, Quote 29).

The dabate over whether a regional, systemic or combined approach to curricular presentation continues (Moxham and Pais, 2016). For example, the systemic approach may not be best suited to dissection. It might not allow the overall perspective necessary for identification of structures and how they interrelate to each other (Stabile, 2015). Hence, Stabile (2015) suggests a combination of approaches may be the solution to this question.

5.1.19.3**'Bare bones': defining anatomical course 'content'**

The 'Bare Bones' of the skeleton protect and envelop or support much of the 'content' taught in gross anatomy programmes. Hence, within the same theme but under the subcategory 'content' participants identified anatomical structures, regions and systems that they felt should be included in or excluded from the anatomy curriculum. They also discussed the language of anatomy that was unfamiliar to them as an undergraduate student.

For particpants in FG3 the understanding of anatomy was not hampered by the complicated names of structures:

***'**The Latin…name?'… **'**It was easy to grasp.' **'**It was fascinating to learn new words and …and also knowing there's this Gluteus Maximus (a little laughter within the group.'… **'**Then you get used to saying that name and you (murmurs of agreement from other members of the group) understanding by that name and it becomes part of what you do…' **'…**And then you understand the names came from sometimes like describing what the muscle did…or where it was…' **'…** and then you appreciated that and then it added more value. But just got used to the name…the name's the name' FG3, Quotes 71,74,75,82,84,86).*

Many participants raised the importance of the spinal cord and the brain and prioritising the learning of the brain was included:

'*You know like I might …I might…I might just be mistaken. I might have just been so overwhelmed that I missed it…I might be…but I don't remember like people teaching me the spine properly… I think definitely more spinal cord things. It goes together with brain and all the tracks. I remember I had no clue of what was happening with those tracks' (FG 4,Quote 154)* and ***'**But I think they did too little with the brain. I think they kind of touched over …err…err…everything is connected to the brain. I think it should be like the first thing that we learn (background murmurs of agreement from some other members of the group …' (FG4, Quote 110).*

It became clear that because students are doing PT the study of the upper and lower limbs is deemed important. Youdas, Krause and Hellyer (2015) state that at the Mayo School of Health Sciences the anatomy programme emphasises the musculoskeletal aspects of the subject. This emphasis is illustrated in the following comment where a participant in the academic FG notes this fact and shows appreciation for the prioritisation of these anatomical regions.

'*They spent most of the time for us on upper limb and lower limb and then they had lesser amount of time with the other like structures that are important but not specifically the most important ones. So that was nice' (FG5, Quote 135).*

Youdas, Krause and Hellyer (2015) also mention inclusion of the anatomy of the lungs but did not specifically include the intestines. The general feeling among the participants across all five FGs was that although the lungs should be included in anatomy curricular content related to the intestines and structures such as the greater and lesser omentum were not as relevant to PT anatomical education and information about them should be reduced.

A participant illustrated this by saying:

'Ya! The lungs are really important for us like to learn the anatomy but I think like learning about all the intestines… of course you need to know the basics but I think we went into way too much detail '(FG2, Quote 146).

In recent times focus has shifted back to the importance of fascia in PT clinical practice. At the WCPT 2017 congress held in Cape Town, South Africa Adstrum (2017) presented a poster entitled ' Is physiotherapy endorsing an incomplete version of human anatomy?' This qualitative investigation into how New Zealand educators taught allied health students including PT students about fascia yielded interesting results. Adstrum (2017) concluded that the traditional anatomy dissection pedagogy taught in New Zealand still ignores the 3D, dynamic fascial component of the body. The researcher extrapolates the findings to suggest that globally a new attitude should be applied to the practice of removing the fascia piecemeal with no consideration of its importance in future PT clinical practice. In this respect a participant said:

'Fascia…you just cut that thing away so you could go to the muscle and try and get the muscle as best you could' (FG3, Quote, 189).

It was generally agreed by participants that muscles, bones blood vesels and nerves should be included but apart from the gastro-intestinal tract there was little dogmatic non-inclusion strategy revealed. Perhaps one participant summed up the dilemma of the content matter when she said:

'Now looking back I understand just do the whole anatomy. Don't cut things out. You have to know full anatomy to be able to clinical reasoning but while I was in it I couldn't understand what the hell we're going to do with all this?' (FG 5, Quote 129.)

The way in which the gross anatomy course is delivered to the students incorporates a number of factors.

5.1.19.4 **'Bare Bones': the 'when','frequency', 'duration','structure' and 'goals' of the gross anatomy programme**

The 'Bare Bones' give the added 'structure' that the human body requires but under the subcategory pertaining to 'structure'of the course some participants had been taught in a modular fashion while for others the course had been divided into quarters.

***'**First year it was lower limb. Second year it was upper limb …we did a little bit on the brain…. both the theoretical part and then dissection at the same time depending on the module.' (FG4, Quote 13).*

'So our anatomy was broken up into four different quarters and the first quarter was the bones, second quarter muscles, third quarter was systems and the fourth quarter was I think …the brain ' (FG2, Quote 14.)

Within the detail of this theme the subcategory of 'duration' and 'frequency' of anatomy lectures, tutorials, dissections and prosections varied widely across the different courses.

'When' the courses were held also varied from:

'…We did first year anatomy"' (FG3, Quote 8).

***'**We did it in our second year and it was a year module…..' (FG4, Quote 14).*

However, one course in particular differed from the others in that it took place over two years and was integrally different:

***'**But then we had anatomy and physiology intertwined so over the two years we did anatomy and over the two years we did physiology' (FG2, Quote 128).*

One participant referred to the 'goals' that were set to enable structured dissection:

'…We were given sort of…um… goals to meet each week where we had to dissect…for example…the shoulder by end of week two, elbow by week three or whatever it was…' (FG 3,Quote13).

5.1.19.5 **'Bare Bones': the pedagogy**

In totality pedagogy used to teach the subject of gross anatomy enables the student to see, feel, visualise and interact with the contents of the human body either in a virtual way or through direct interaction with human cadaveric tissue.

With the coming of the technological age the use of computer assisted learning has been increased. In Chapter 3 of this thesis the Study 1 (Paper 2) scoping review uncovered some computer assisted learning studies using PT students as participants (Table 3.3). The three most recent looked at technological interventions in general gross anatomy (Thomas, Denham and Dinolfo, 2011) and in the teaching of neuroanatomy (McKeough and Bagatell 2009; Foreman et al., 2005). One participant in this FG study reported that:

'We had the access to the computers but okay so it is almost ten years ago so there wasn't that access to high speed internet at home and anywhere you go Wi-fi wasn't such a big thing so it was more a case of you going into the library sitting or the computer labs being at the computer there and then looking at it but if you don't have the time for that then …then it's a problem' (FG3, Quote 255).

Access to a high speed internet and the use of home computers and portable devices is reality now and this has led to improved access and availability of anatomy information and computer assisted learning has become a useful adjunct to the traditional anatomy teaching methodology. In some instances due to the introduction of blended learning this type of anatomy teaching has been increased in a PT gross anatomy programme (Green and Whitburn, 2016). However, one of this study's participants made a valid comment in:

'Because your NOT treating your computer so it changes it completely (Pause) if you (Pause) even if you take your cadaver, it doesn't look exactly the same and the position isn't exactly the same not that anyone's position is exactly the same but Ya! But it's a good add on though' (FG1, Quote 262)

In Chapter 2, Section 3 of this thesis the Visual, Aural, Read/write and Kinaesthetic (VARK) learning style model is described (Cherry, 2017). In this regard some students are predominantly visual learners. One teaching method that is possibly overlooked in this day and age is the drawing of anatomical structures on a blackboard. In this regard a participant said with some degree of admiration:

'We had a …a guy. I don't know his name now but we called him Picasso because he loved to draw. He'd start from literally…and draw each thing… and then would draw the attachment of one and then draw something else and then if he wanted to change the view he would do that so I mean for me personally without something visual… .I learn from pictures …I mean this thing …that was the best thing for me. I was able to see that. He was able to do that very nicely that's what I liked' (FG3, Quote 109).

One participant liked the use of the blackboard but another did not find it helpful.

‘ I think the blackboard was… that all I can remember is the brachial plexus then was always on the blackboard …and then a lot of the cross-sectional areas were on the blackboard and the back of the muscles which also helped to like see through…’cos your not going to dissect through the leg that way so it also helps to see…I didn’t mind the blackboard’ (FG2, Quote 143).

‘I had troubles with the blackboard thing. Ya! I had troubles ‘ (pause)(FG2, Quote 147).

Other pedagogy like lectures, the use of textbooks, anatomical atlases, and the use of the blackboard were described. Lectures were not very popular and were found boring by some participants:

‘…Very long, tedious with lots of information lectures…that I used to fall asleep in …’ (FG5, Quote 20).

The pedagogical journey now continues into the realm of student interaction with dissection and/or prosection of human cadaveric remains.

5.1.19.6 **‘Bare Bones’: student interaction with cadaveric material**

The ‘Bare Bones’ of anatomy suggests that this theme investigates the integral components of anatomy education such as those categorised under anatomy teaching methodology. In the sub category ‘teaching activities and materials’ the most adopted pedagogy overall was dissection. Reimer, Laurenzano and Tages (2013) in a survey of PT clinicians recorded that, although anatomy dissection had decreased somewhat between the survey by Mattingly and Barnes (1994) and their own survey, it was still the most popular anatomy pedagogy.

(Referring to dissection) ‘I loved it. I just found it fascinating so for me it was great. I loved being in the lab investigating and …’(Pause) (FG 3, quote 34).

However, it was not a favoured pedaggy of another participant:

‘I didn’t find dissection helpful at all’ (FG 4, Quote 37).

Prosection was used to a lesser extent. In this study it was clear that in the public and academic service delivery sectors this was the case but in the private delivery sector there was more of a balance in this regard.

‘We used to do our own dissections but then in the front of the hall…I don’t know if it was the same for other years but in the front of the hall we had a cadaver that was done properly so like not us tearing and ripping (some laughter in the group) and

cutting and slipping and slicing wherever but it was like done proper, proper that you could also go and look at…um…so that …that was slightly more useful than when I felt I don't know in dissection ' (FG4, Quote 41).

The above quotation marries a very vivid description of dissection as carried out by students to the more pristine and anatomically correct prosection on a demonstration cadaver. It perhaps gives credence to a combination of the two types of pedagogy. However, as described by Granger (2004) and Marks Jr (2000) mental 3D imaging associated with dissection is linked to beneficial anatomy retention outcomes. A participant in a public sector FG referred to this 3D effect achieved during dissection.
*(Referring to dissection) 'Um**…**I think it helped me see like I mean to visualize all the layers so like… so like the leg…um … just to see like …to say that soleus is behind gastrocs ' (FG2, Quote 156).*

Azu et al. 2012 reported that three–quarters of the medical student respondents to their survey found the use of plastinated material very useful.
Another pedagogy identified by this study and commented on by a participant was that of observation and interaction with plastinated specimens. This participant also referred to being able to revise in the anatomy museum.
'…We had …um…the plastinated models as well to study with on our own and we were also examined with and then access to the anatomy museum where we could…er… revise work ' (FG 6, Quote 19).

A FG3 group member described a novel and innovative way of teaching using the anatomy museum facilities:
***'**We had a similar thing…we call it… IT'S HORIBLE…we call it the 'biltong book' (Laughter from the group). We called it the 'biltong book' but it was open like twenty-four hours… the lecturer who taught anatomy would go before…like a week before the test…say this week we're doing upper limb …she'd like rotate and move things around so like it's all the upper limb things so it's easy for you to go there in your free time and revise upper limb because all the upper limb were like sort of displayed and marked so that helped a lot. That really, really helped. You'd could go in own time and match it and…'(FG4, Quote 36).*
This was obviously a very helpful way for students to revise their work at their own pace and at their own convenience. The afore-mentioned points deal with pedagogy used to teach PT students in South Africa and this is in keeping with the objectives of the study.

5.1.20 **Theme 2: Anatomy: 'A Touching Experience'**

Anatomy can encompass the physical touching experiences of dissection, handling of plastinated specimens and performing surface anatomy but on a different level it can also be an emotional journey where psychological factors have to be factored in to the various pedagogical and curricular considerations. The emotional 'touching experience' may impact on how the student learns and whether successful outcomes will be achieved. It therefore may play a role in how consideration is given to the way in which pedagogy is presented to students or included in a curriculum.

5.1.20.1 **'A Touching Experience': Surface anatomy**

A possible contentious area of anatomy learning is the use of surface/living anatomy because gender, cultural and religious factors can have a bearing on its use (Reid et al, 2012; Rees, 2007). This subject has been covered at length in Chapter 2 (literature review) of this thesis. In this study many particpants felt that it was a useful pedagogy. Below a participant describes how better surface anatomy instruction would have led to better perception of the depth of anatomical structures in general but particularly in enabling more successful dissection.

'I think with us they just told us you've got to get the surface anatomy we're going to start there. And that's where we started. It was never why surface anatomy's important. Why do you need to have a starting point to get to the deep end? That's why I think the dissection was a mess because the minute you cut in, your cutting into everything that's superficial and important (laughter from the group)…and your suddenly then at the deepest muscle and your like …ugh…that's it I found it. So I think no one ever touched on surface anatomy in terms of like …things are very superficial …you need to look or things are either like very deep in and you need to cut a bit deeper so I think that was why dissection was also a bit too deep because you didn't actually know what you were doing. What is surface anatomy? How deep or how superficial is it?' (FG4, Quote 76).

And yet another three participants related its importance to the learning of anatomy for clinical practice and the associated 'clinical implications'.

'You have to touch patients and all. So I think that information that you get from the outer surface of the superficial part will make much more sense. To me it will give much more information on what is going on inside. So I felt like the surface anatomy is also as important as the deeper muscles and the deeper tissues' (FG4, Quote 78) … ***'***I think that you need to apply it and that your physical touching, feeling. We're manual labourers really. Use our hands. We have to feel. We have to, I mean how

much of our assessments and everything are done looking and feeling?' (FG1, Quote 265)…

The methods of application of surface anatomy techniques using crayons or paint are well documented in the literature (Estai and Bunt, 2016; Nicholson, Reed and Chan, 2016; Nanjundaiah and Chowpurkar, 2012; McMananin, 2008; Rees et al., 2005). A participant in a public sector FG commented:

'We had to draw on each other. So we were in groups and we had to draw on each other …um...different muscles and they would correct us and I found that really useful' (FG2, Quote 166).

Surface anatomy is often carried out using the male members of the class as volunteers.

***'**Well it was volunteer-based and usually the boys would (someone says aha!) so…um…ya it was the same in physio class. Like if you had to get suitably undressed you did it. Our class you know…you asked the class…the class was asked if it was okay. If someone had a problem with it then they were welcome to leave or study it by themselves but no one ever had a problem with it and it was always the boys actually that did it' (FG2, Quote 170).*

5.1.20.2 **'A Touching Experience': 'Emotional response to course content and timing' and 'Impact of dissection on student psyche'**

Sándor, Birkás and Györffy (2015) found that dissection, in particular, had emotional relevance to 50% of medical students surveyed. The psychological effect of learning anatomy is examined in the subcategory of 'emotional response to course content and timing' that falls under the category of 'anatomy teaching methodology'. It illustrates that both positive and negative emotional responses are attributed to this phenomenon. On the negative side the tremendous workload as perceived by students was alluded to by many FG participants and they elaborated on how this had often caused anxiety and even emotional distress as is illustrated in this quotation:

'…I would like (and she gives an embarrassed laugh)…I would cry about that thing and I never cry …I NEVER CRY…like someone else …I was crying and I'd phone my mom…That…the load…it's so much and they cram it all into like one year…um…'(FG 4, Quote 187).

And perhaps a mixed response was seen where a student would undergo an unpleasant anticipatory emotional experience but endeavoured to reason away this

feeling by balancing it with a positive learning one. Allen (2015) pointed out that Vannatta described a student's first encounter with a cadaver. Vannatta said 'To walk into a room and start cutting up a human being's body, it's not normal.'

'I cringed the first day (laughs nervously)…um… but I thought it was really good to actually visualize…because I'm… I don't know about you guys but I'm one of those sort of people that learns better by looking at something and visualising it…so I thought the cadavers were good' (FG2, Quote 109).

An unanticipated subcategory that produced many telling, interesting and insightful quotations was that of 'Impact of dissection on student psyche'. These 'touching experiences' highlighted the need for sensitivity and understanding to be displayed by lecturers and fellow students during dissection. In some students the dissection pedagogy aroused profound emotions. The quotations also identified specific parts of the body or scenarios that impacted on a student's psyche.

'The smell'

Getachew (2014) in an Ethiopian study noted that many researchers report students' revulsion with the smell of the cadaveric material. Leboulanger (2011) found medical students rated the smell as their main concern and after a month one of those students said that the smell 'followed [her] for days'. Similarly, Snelling, Sahai and Ellis (2003) found that perception of 'the smell' of dissection got worse for medical and dental students as time passed. In a study of 100 students in Australia 30% were found to reference the 'horrible smell' (Robbins et al., 2008-2009; O'Carroll et al., 2002). A participant in this study found a very anti-social response from the family in relation to 'the smell'.

'…Then my mom and my sister are not medically inclined at all so I literally had to strip myself down outside the house and shower outside in like commercial quarters and stuff before I was allowed inside the house because they couldn't take the smell so that was a bit hectic in the beginning' (FG3, Quote 103).

Cadaver's face: to look or not to look?

This study identified both points of view regarding the unveiling of the cadavers face and the impact of this act on a student's psyche. In a French study Leboulanger (2011) found the face and eyes were one of the main concerns raised by students after dissecting. A study by Robbins et al. (2008) produced a quotation pertaining to the 'personal' nature of seeing the cadaver's face. The quotation below by a participant in this study also expresses a similar opinion.

'…*I'd never look at the cadaver's face because the moment I'd look at their face to me that made them a person. Like we all have arms…all have legs…all have bodies…um…but it's like your facial features that make you an individual so like luckily with us we never had to dissect the face and I never ever had to see it. It was covered every …um…every session... I didn't want to know what they looked like before or who they were like that would have made it…it makes it too real. So I was fine knowing it was a person but not knowing who they were…' (FG4, Quote 195).*

However, another participant in the Robbins et al. (2008-2009) study like a participant in this study was not upset to see the face:

'*I remember very clearly…I can still see the cadaver's face very clearly. Never mind the anatomy and any of that I can…you know I remember when I looked…I wasn't upset by it…' (FG5, Quote 112).*

The 'Dolly's ring'

A study conducted in Hungary found that when students were asked whether they considered the cadaver as if it was plastic or a dummy found that only 7.4% fully agreed with this statement and over half of the particpants (55.4%) did not agree at all (Sándor, Birkás and Györffy, 2015). One participant in this study compared the cadaver to a doll but when the ring was seen on the finger of the cadaver there was a realisation that the cadaver was real and had lived a life.

'*Even…even to me it was…it was not that emotional but I got emotional once when I saw a cadaver with a ring (participant seems emotional even relating this incident) …I was like this person…where's the wife here? And I felt so emotional because I thought okay maybe this person was lost and whatever…maybe they take this person. So I got attach with that because get me many thought about it and what's happening around this person and it's better just get a killed cadaver without anything on it …that's it and then you're just dissecting and you're thinking …Aye! It's a dolly….'(FG4, Quotes 188, 191).*

Cause of death

Weeks, Harris and Kinzey (1998) reported on the fact that identification something like cause of death can personalise a cadaver for the student. A participant in the academic FG did find that this was the case:

'It was quite a big impact knowing what he died of. So he had died of skin cancer and …um…and as we were dissecting and especially when we were removing the skin underneath the amount of things spread everywhere and how badly riddled he was and that had a huge, huge impact on me knowing him as a person as opposed to

just…once they're open and your working with …someone you don't recognise…um…it was easier to sort of separate that but putting a disease and a face to him made it more impactful but not upsetting'" (FG5, Quote 112).

Missing loved ones

Fountain (2014:182) writes about how a student remarked that the cadaver looked like her grandma and how this is perhaps how students would relate to an older female cadaver. A participant recounted a similar traumatic experience of a friend:

'The thing that was also hectic for me was that one of my friends lost their grandmother …um…during the dissection right at the beginning and she was…her cadaver was female and looked just like her grandmother so for her to go back to dissection was quite hectic after that so it was quite emotional for her and for me to try and help her through that was quite hectic…' (FG3, Quote 103).

De-registration from the gross anatomy course

Dissection or examination of prosected cadavers has been described as potentially stressful to medical students (Dinsmore, Daugherty and Zeitz (2001). After a survey of Ethiopian students Getachew (2014) reported that 60% of second year students found dissection stressful and 45% of third year students found it very stressful. In a Nigerian study Izunya, Oaikhena and Nwaopara (2010) found that 35 % of first year preclinical medical students reported feeling anxious and stressed by the initial exposure to a cadaver. Previously also in Nigeria Nnodim (1996) found that 33% of students rated being in the dissection laboratory as a 'very important' cause of stress. Finkelstein and Mathers (1990) reported that one student suffered from symptoms akin to posttraumatic stress due to dissection and seriously considered leaving her medical course. Particpants in this study related instances where students were so severely emotionally affected by the dissection experience that they de-registered from the course:

'For me I do really…it didn't really affect me psychologically. It's more people …my colleagues…my…my…my…my friends were very affected to a point that two of them deregistered for engineering and if you asked them anatomy was one of the…ya … serious problems and also some had to go for counselling but me personally I was the curious one. Even come after hours to do pracs without anyone' (FG5, Quote 119).

'I just wanted to add to what (mentions P6 by name) was saying with not for yourself but with colleagues deregistering so there was also a girl, friend of mine in OT who deregistered because of anatomy. She a few years before had been a rape victim

and this was the first time she was coming into contact of bodies and genitalia and it just brought too much that she…that she…she left OT altogether' (FG5, Quote 123).

'The Gangster'

Moore and Benninger (2014) comment on how, after a period of time, students move from dehumanisation of their cadaver to re-humanising the cadaver. One of the ways in which students do this is to name the cadaver and speculate about their previous life. A participant told the story of her 'gangster' cadaver:

'With us…it was our cadaver that everybody was fascinated at …by…because he was a gangster (group laughter). We found out retrospectively so he had all these tattoos and lots of people came to have a look at the tattoos rather than us dissecting and….um…it was you know …it only really hit hard that he had lived his life and you know…he participated in society… when we discovered that he had a plate on his arm. So he had fractured his arm before. So everybody wanted to see the plate…' (FG5, Quote 125).

Coping with dissection

Sándor, Birkás and Györffy (2015) found that the most common factor raised as a coping mechanism in a sample of medical students was 'cognitive coping'. This involved students looking for a rational and intellectual basis for what they were doing. One participant in FG3 encapsulated this viewpoint:

'I think you're trying your best to not get…not get emotional when you do it…you kind of just keep yourself…your emotions like distant from that and because of that you …you're trying very hard just to see it just as an academic thing so it doesn't really translate 'cos you've already kept it separate' (FG3, Quote 343).*

Nnodim (1996) identified pressure from peers as a coping strategy where a student uses that pressure as a rational reason to have to do something. A male participant in FG3 related to this:

'I was the only guy in the group with girls so I had to cut first (participant P5 laughs). It was also fine I just did it. It wasn't too bad' (FG3, Quote 96).*

Furthermore Nnodim (1996) stated that curiosity and interest could be applied as a coping strategy and this is illustrated by the following quotation from a participant:

*(Referring to dissection) **'***I loved it. I just found it fascinating so for me it was great. I loved being in the lab investigating and …'(Pause)(FG3, Quote 34.)*

5.1.20.3 **'A Touching Experience': 'Emotional response to assessment'**

Participants also identified the emotional responses that students' exhibited during assessment. This again could either be positive or negative in nature.

'*I think that was like really traumatic that we got asked about the lower limb when we had only done the upper limb and I think it just gave everyone a really bad feeling about anatomy…in our first, first test so I think that started with anatomy being a negative thing …' (FG2, Quote 20).'*

It was really enjoyable and the moment that you know that you've exempted or promoted you really feel good about yourself '(Pause)(FG2, Quote 37).

5.1.21 **Theme 3: 'Staff Matters'**

Effective delivery of anatomy pedagogy within the confines of an appropriate curriculum is a function of the staff of the department of anatomy. Zhang (2017) has drawn up a guide for gross anatomy instructors who teach cadaveric dissection to medical students. The idea is that the teacher will become an engaging and amazing facilitator of learning during dissection sessions. Hence, 'matters relating to staff teaching' is an important category within this qualitative study theme of 'Staff Matters'.

5.1.21.1 **'Staff matters': Quality, quantity and motivation of staff**

This study found that there was dissatisfaction with the number of teaching staff in most cases with few participants happy with staff numbers. Zhang (2017) elluded to the fact that, due to the increase in class sizes, each lecturer would have to cater to the needs of more groups of dissecting students. She suggested that an organised plan of action had to be drawn up to ensure that instructors gave adequate attention to each student group. In this study the quality of staff was also criticised with the exception of a few 'gurus' and motivated teachers.

'…There were also staff members…I can't remember what they were called…who would go around and be available from station to station to help you with …um…the dissection…and I remember as a student always we'd really have to vie for their attention for how many students we were and how many assistants…dissection assistants that were … there were …it felt as a student… from a student's perspective a poor ratio 'cos it…we'd would have liked to have gotten more questions in '(FG5, Quote 11).

'I think we had teaching assistant, one or two in the class and the lecturer would be there but (Pause) Ugh! They didn't really help much. I don't think they had good training at that stage. Ya! So it would have been better if they had proper training 'cos they would just stand in the corner and you know whatever '(Laughter from the group) (FG1, Quote 97).

However, sometimes the participants expressed satisfaction with the staff numbers and quality.

'I can't remember how many assistants there were but we …I know that we always felt that it was fine …ya. If you needed help there was always someone close by' (FG3, Quote 330).

'I…I enjoyed the theory and the prac equally. I think for the theory part it was because we were taught by gurus…um…very funny professors who'd written books and articles and everything and during lectures they were very passionate you could see ' (FG5, Quote 38).

'For me I thought the…the…teaching that was provided to us was more substandard compared to what medicine and the other groups were receiving. Even lecturers they knew their work but you could see that they were just doing it because they were asked to do it. They are not putting a lot of effort. Not giving much attention to us' (FG5, Quote 36).

The quotations clearly illustrate the relief and happiness of any student who is being stimulated and motivated by the lecturer and the disappointment and feeling of abandonment felt by those who were not being helped sufficiently.

5.1.21.2 **'Staff matters': Staff language and communication**

A problem that was identified by FG3 and FG5 was that when the lecturer speaks with a heavy foreign accent it is difficult to for students to learn. Another problem raised was to do with softly spoken lecturers.

'We also had a… some lecturers that really we could not understand (Laughter within the group)…anything they were saying 'cos they said they were speaking English but …' (FG3, Quote 27)…(Interrupting) 'They weren't…("more laughter)(FG3, Quote 28)…' 'They were foreign' (FG3, Quote 30)…'Very foreign' (FG3, Quote 32).

…' I really, really battled to hear the demonstrator or the tutor and I would always have to sit on top of them so I could hear what they were saying (group laughter)…' (FG2, Quote 61).

5.1.21.3 **'Staff matters': Staff continuity**

A disruptive element to staff matters is when staff continuity is not maintained especially if this occurs often. A staff member who had been at an institution for a long time on the other hand contributed by creating summaries of the subject and students found that very helpful.

'So ours was quite disruptive through our year our staff changed literally every semester ' (FG3, Quote 26).

***'**What helped us like…what helped us a lot is like we didn't have a specific like…a specific textbook for anatomy but we had like uh…it's kinda like a summarised…our lecturer had actually made 'cos he'd been teaching anatomy for don't know…centuries now (laughter from group members) I'd like to say that he'd been there for quite a long time' (FG4, Quote 59).*

5.1.21.4 '**Staff matters': Relevance of staff professional affiliation**

Over many years the debate has raged as to whether anatomy should be taught exclusively by anatomists or, in the case of the teaching of health sciences students, whether clinicians in the specific disciplines should be brought onboard to give the anatomy a greater clinical bias. The importance of the inclusion of clinical input in gross anatomy course designs (Stabile, 2015) and the inclusion of functional and clinical relevancy has to be factored into gross anatomy curricula (Obeidat, 2013). Many researchers maintain that PT practitioners should teach the gross anatomy curriculum for PT students in order to safeguard this clinical element (Reimer, Laurenzo and Tages, 2013; Latman and Lanier, 2001; Armstrong and Rosser, 1996; Mattingly and Barnes, 1994). However, these PT anatomy instructors must be well versed in teaching anatomy and can therefore be termed suitably qualified staff. It was made extremely clear from the FGs that the participants felt that suitably qualified PT staff would be preferable gross anatomy instructors. The following quotations attest to this finding.

***'**Our table doctor was a physio so she related a lot of what we were seeing and doing to patients we would see in the future so that made it quite relevant to us so I really, really enjoyed the dissection…' (FG5, Quote 33)*

***'**From my side like we had like…the other thing is that we had like…like a medical doctor actually teaching us like anatomy so it makes much more sense when it's a physio that is going to then because he's able to come up with examples that will actually help you because sometimes you understood all the anatomy and all that. It was all good but to link that to our profession it makes much more sense when it's a physio that's actually explaining because he actually…he will actually know what to explain more in depth … and when we did anatomy it was such a basic overview of the lungs that there's no like…it doesn't link up…it doesn't connect so for one you're learning this extreme detail…for the other it's not as applicable … for example, scapula-humeral rhythm so I know the muscles that are there but I don't understand how it works so when I'm learning about the muscles to put the whole picture together*

so like it links the anatomy and the physio into one not just this is what you learn for physio and this is what you learn for anatomy' (FG3, Quote 53).

5.1.22 Theme 4: 'Student Embodiment' in Anatomy

5.1.22.1 'Student embodiment': 'Student readiness: maturity and self-responsibility'

The role of student input in the successful conduction of an anatomy course cannot be overlooked. In this regard Nagar et al. (2012) found that the opinions of medical students should be considered and that there is sound reason and justification for such input. The opinions of the FG particpants regarding their recollections of their student days in a gross anatomy programme helps determine what factors might influence better uptake, understanding and retention of anatomy. When most of the students enter an anatomy programme it is in the first or second year of their university course. At that time the majority are between 20 and 23 years old. The category of 'student readiness' identifies an inate immaturity in these young students. In a study conducted with Malaysian medical students the researchers found that adult learning and emotional maturity go hand in hand and therefore health sciences lecturers need to pay cognisance of this fact when teaching such students (Bhagat et al., 2016). One aspect of this immaturity has been discussed with reference to the handling of the 'Bare Bones' in the initial part of this discussion.

Two comments that really did show a level of immaturity in the student years were:

'I had a funny experience. I was very dedicated in my first year, first weeks and I remember working 'vooruit skryf' and then I summarised the things and I left out all the detail because the names were just too long. So I just left it out! (General laughter from the group) Cos you didn't understand what it meant to have a flexor carpi radialis brevis. So when we actually got to the stage where they explained what the, what the Latin means it was oooh! (With a facial expression indicating surprise) You have to have all the parts! '(Lots of group laughter)(FG1, Quote 37).

(Referring to surface anatomy) 'Okay quickly draw this and it was… we were all like Ha! Ha! Ha! Now we've got drawings on ourselves (laughter from the group). Why? Why would we? Oh! Oh! What is this?' (FG4, Quote 80).

One member of the first private practice FG gave the perspective that maybe reflecting on the mentality of the younger self one should consider being a little sympathetic and taper the expectations regarding what is expected of a student.

… 'I think we have high hopes for our younger 22- year old selves to do all that and still be students. I don't think we should take it away I just think it could still be a

hindrance to teaching is that you are 22 and most people are either looking to marry, or looking to Com Serve or looking to finish' (FG1, Quote 248).

5.1.22.2 **'Student embodiment': 'Student readiness: Learning techniques and experiences'**

The context in which a student learns anatomy does impact on how well they learn the subject (Smith, Martinez-Álvarez and McHanwell, 2014).

Particpants described various methods of learning some of which were more helpful than others:

'What I loved the most about ours is like we also had like…we had …a section whereby they just run through everything like everyone in the class would be there …the lecturer will be there and they'll be those pins in the nerves and the muscle and all that… It's a room full of cadavers. Maybe you're doing the upper limb or doing the hand… and there would also like be pins…. So it's like an overview where the lecturer will just explain everything and then just go around groups …then after once that is done then you can start dissecting. So that was quite nice. Even if you don't actually have a chance to actually dissect or see those muscles during the dissection session at least you know what's what…' (FG4, Quote 34).

'I learnt it off by heart. I could get full marks on it. I was too happy when they asked me but I understood nothing….' (FG4, Quote 154).

Self-study

Once a student reaches university they are expected to become autonomous learners as opposed to the more dependent learner in the school situation where they have much more guidance. The FG participants in this study had learnt anatomy in either the first year out of school or after one year of initial university experience. Many participants bemoaned the lack of specific direction and the amount of self-study required:

'…I feel like it was a self-taught subject really. You went in and they kind of said… when you did dissection …it said okay dissect and we were kind of dissecting and we didn't really know what we were dissecting and it wasn't very specific' (FG4, Quote 11).

'The theory was very rushed so that's why most of it was self study …um… they used to just say read this and this chapter from the textbook and go and do it at home…' (FG4, Quote 12).

Innovative learning techniques

An innovative learning technique such as the MCOE in the intervention by Gangata (2008) was described in Study 1 (Paper 2, Chapter 3) of this thesis.

A participant in the academic FG described an innovative learning technique:

'I had a ball and I wrote each muscle down on a little piece of paper and I'd pull it out and see if I could say the four points about it. Pull out the next one randomly and I just remember doing that FOR HOURS' (FG5, Quote 67).

Peer teaching as a learning technique

Successful examples of peer teaching involving PT students alone or in inter-professional education have been reported in the literature (de Oliviera et al., 2015; Wait et al., 2009; Youdas et al., 2008). An example of individualised peer teaching is explained in the following quotation:

…'*Time spent and often with a colleague as well where we were working together slowly with our textbook at our own pace going through the model, looking at that, asking each other questions and I had the fortune of a friend who had a bad eye accident (group laughter) and missed a lot of lectures and had to be taught everything and I spent many hours with her at her house and in the prac labs helping her to catch up the work and the most that I remember is the stuff that I had to teach her' (FG5, Quote 62).*

5.1.22.3 **'Student embodiment': 'Student experience of course content, assessment, motivation and perception'**

A gross anatomy curriculum needs to take cognisance of students input (Collins, 2008).

Focus group participants from all service delivery sectors gave input in this category with regard to how to learn anatomy:

'I did not like learning the content off by heart (laughs) so it was never the subject I did best in because I think there was a lot of memorisation rather than problem solving' (FG5, Quote 33).

'…A lot of the time you actually learn the anatomy of structures. I know what the arm can do. I know what the leg can do but what does it apply to me and most of the time because it's…like we had it over the course of a year and over a year you had to cover theory and practical and the aim was always to pass…I need to know this, this and this to pass. Not I need to know this because one day it will assist me figuring things out as a physiotherapist but more I need to know this to pass' (FG4, Quote 46).

Learning anatomy by rote

The learning of anatomy by rote as in by listing facts for example can help with some of the immediate recall of some structures but is not effective for long-term recall.

A participant in one of the public sector groups described anatomy in this way:

'And I think anatomy is very intimidating when you get a huge text -book and then you think Oh my word! How am I going to learn this? And then you start picking things that you think and then you parrot learn so you can pass. You're actually learning NOTHING…ABSOLUTELY NOTHING…'cos then next week if someone asks you…you won't know and you're just trying to squeeze as much as you can into such a short period…' (FG4, Quote 60).

5.1.22.4 **'Student embodiment': Little pieces of the clinical reasoning puzzle**

It has been suggested that a gross anatomy curriculum for undergraduate PT students should utilise physiotherapists as instructors (Reimer, Laurenzo and Tages, 2013; Latman and Lanier 2001; Armstrong and Rosser, 1996; Mattingly and Barnes, 1994) and have clinical relevancy for PT practice (Moxham et al., 2014; Johnson, Charchanti and Troupis, 2012; Latman and Larnier, 2001). A definitive clinical presentation of the role that anatomy is going to play in future practice during anatomy instruction may have prevented the lack of clarity that one FG participant felt as an undergraduate. It was only in hindsight after clinical experience the pieces of the puzzle came together to give the bigger picture:

'For me I think while I was doing that I often wondered why are we doing these things and we …but now that I look back it just makes sense to know anatomy so while I was in the situation I questioned a lot. … this bones of the skull for example but now that we are done with it it's almost as if it...it…it…maybe we don't have direct contact with the bones of the skull or any role with it that I think about but it does fill a small little piece of the puzzle in your clinical reasoning all these …you know where …that are holes in the …I mean we know here…here's a little 'gaatjie' something comes out' (murmurs of agreement from the group)(FG5, Quote 129).

5.1.22.5 **'Student embodiment': Student assessment**

Student assessment in anatomy can be formative as in progressive tests throughout the period of the anatomy programme or summative assessment at the end of it (Mitchell and Mitchell, 1998). Evans, Zeun and Stanier (2014) showed that formative assessment, when applied in a spaced-education format, offered an assessment journey that provided an incremental and progressive approach to learning. The formative assessments assisted students with a gradual learning path and avoided a focussed learning period followed by a once off final examination.

A participant in the private sector alluded to a formative assessment methodology: *'…and then you'd have every week …um…a test and then you'd have eventually a practical exam as well that you'd have to pass and get a certain mark in order to promote or you'd write the exam' (FG2, Quote 17).*

'Positive assessment' or 'negative assessment'

In this study whether assessment elicited a positive or negative response from students was particularly obvious with regards to timed spot tests. The literature does not delve into students' responses to the spot test phenomenon with regard to its possible psychological impact on examination performance. In this study mixed feelings were found among FG participants with somewhat more negativity expressed concerning the time allowed for such assessment and the consequential pressure experienced by a student:

'And we also had spot exams as well (murmurs of agreement from the group and one person says Oh ya!)…which were actually really great though… 'cos that helped me…it helped me a lot.(general agreement from the group)…Ya! That helped me a lot' (FG2, Quote 29).

'… because we had like this one minute stations where you get like a minute with the flag to name it and I mean if you don't know you don't know and when that buzzer goes you have to move to the next thing …and you can't even remember to think okay maybe it could be this maybe it could be that if you've missed it you've missed it. You have to have such a good knowledge…' (FG4, Quote 58).

Mitchell and Mitchell (1998) suggested that if a student attained a 60% average mark for the year up to the final assessment period it was extremely likely that they would pass a final examination and therefore exemption from that final assessment should be considered. An FG participant found this an incentive to attain 60% for the year.

'I think the best thing for me was that if you got more than 60% for your year mark you didn't have to write the year…' (FG3, Quote 146).

5.1.22.6 **'Student embodiment': Ethical considerations**

Within any anatomical curriculum ethical matters are addressed with suitable decorum and dignity. Physiotherapy students will go on to be practising clinicians and will have ethical responsibilities in that regard. Dissection can instill professional behaviours or behavioural and humanistic perspective in PT students (Youdas et al., 2013; Canby and Bush, 2010). Prosection can lead to an understanding of the 'donor's gift '(Kawashiro et al., 2009).

Initial dedication

Before students proceeded to dissect a cadaver, view prosected material or handle plastinated specimens various rituals were perfomed to desenthitise students to the task but also engender respect for the cadaver and appreciation for the tremendous gift made to them by that person (Riederer, 2016). Jones, Lachman and Pawlina (2014) described how donors were honoured in medical memorial ceremonies in the USA. Similarly a FG participant remembered that:

'I think it was very well handled your introduction and it was quite a solemn…um…event…the initial dedication of the cadavers and whatever ' (FG5, Quote 113).

'When we started with anatomy (Pause) the first lecture I remember it very vividly. There was a cadaver on a table with a cloth over and the whole lecture was just to get everyone desensitized and comfortable and it was very respectable. I remember it now still so I think that definitely helped and that was good (Pause) not necessarily I don't think I would have more respect or less respect because I worked with wet specimens instead of the whole cadaver.mm…mm…I don't know if that would have made a difference. But in the beginning it was very respectful and nice and they did try to implement the fact that… It was always stated that you were working with people. It's not something you can throw around and not …that type of thing' (FG1, Quote 62).

Introduction and history

Another important aspect of this procedure was the introduction to the cadaver:

'We were introduced and you were given a history and…um…you know a briefing about the patient and that they either donated or they were unclaimed status' (FG5, Quote 125).

Ethical guidelines

Shaikh (2015) discusses considerations relating to how medical students should apply themselves in an ethical way towards their cadaver. However, a participant in FG 4 points out that students do not always exhibit the necessary amount of respect for cadaveric material saying:

'I think this even also there's not a lot of respect for cadavers (murmurs of general agreement from the group) so that's why I feel like when there's stress in dissection let us do it properly because people really do make a mess of things (group member agrees) and dissection is taken very lightly but it's an actual person so I think that's what needs to be emphasised and even through the dissection process there has to

be properly because at the end of the day this person…whatever…donated their body so that we could learn. So I think that's where that needs to come in it's just like some form respect …a body's been put forward here' (FG4, Quote 194).

The standardisation of ethical guidelines has been proposed by two students in the USA to enable students with the understanding of gross anatomy ethical expectations (Kahn and Gardin, 2016). A participant in this study requested that the ethical guidelines should be clearly defined so students would know exactly what they were allowed to do or not do with regards to interaction with cadavers:

'But I think also as an addition I think it would be like…it would make much more sense if they would just brush through the ethical biography. Like explain that you're not allowed to take pictures. Know that you might be seeing this show. So at least they are preparing emotionally so that when we get there we know exactly what to expect also what not and what to do. So we nev …never got that because one of my friends was actually in trouble for taking a picture of a ca…ca…cadaver. We didn't know that we shouldn't take pictures you know so just I think also as…as…as an addition they should just brush through even if they're not going into nitty gritty details but just brushing through the ethical component of what we should do what we shouldn't do what must …what we going to expect…um… in the dissection room' (FG4, Quote 196).

However, another participant in the same FG had no dilemma about ethical considerations as these had been clearly explained.

'I think they were more strict with us with that …um…like you weren't allowed to enter without a lab coat on. You weren't allowed to sit in that dissection hall without a lab coat. Like if a phone was seen it was unacceptable. You know you were always supposed to have your student card showing so that they knew you were allowed to be there. So with us they made it very clear and even in…we had dedication ceremony before we started and when we finished and the whole idea like was in it was they kept reiterating…You must remember this is somebody's husband or wife, chi…like daughter, son, mother, father. This is a human being and have respect for that so they were very good with us with laying that down …making sure we WERE aware of it' (FG4, Quote 197).

The previous two quotations illustrate the diversity of ethical instruction given in two different universities in South Africa.

5.1.22.7 **‘Student embodiment’: Cultural and/or religious consideration**

This phenomenon was really only apparent with respect to surface/living anatomy. It was reported in the literature that the majority of female Muslim students cited religion as the reason for not wanting to take part in peer surface anatomy sessions (Das et al., 1998; O’Neill et al., 1998). In this study a participant confirmed that this situation also occurs in South Africa:

“We had a couple of girls…um…Muslim… who didn’t want to. Some of them took off their head scarfs and that’s as far as they went…they wouldn’t undress and…” (FG2, Quote 171).

5.1.23 **Theme 5: ‘Gross Anatomy Classes’**

5.1.23.1 **‘Gross anatomy classes’: Charasteristics of classes**

In this study matters that arose were not directed towards the size of lecture classes but were related to numbers in tutorials, practicals other than dissection and number of students in dissection groups.

5.1.23.2 **‘Gross anatomy classes’: Size of classes**

A participant gave some insight into actual sizes of tutorial and dissection groups saying:

‘…then there were also tutorials… and those were smaller groups maybe fifteen, twenty people…in dissections as well we were a group of six to eight people…’(FG5, Quote 9,11).

Tutorials can be a popular method of anatomy teaching as reported by Snelling, Sahai and Ellis (2003) if tutorial group sizes are small so there is focussed transference of knowledge in such a group. One participant put into words what a lot of particpants felt about the general size of anatomy classes and related this to problems with hearing what the tutor had to say:

‘*But I also think that given the tut classes …that are in the labs down there in the underground (giggling from group)…em…it was too big…like the anatomy classes were too big… ‘ (FG2, Quote 61).*

A participant in a public sector FG attested to the fact that small group size was better in general by saying:

‘We just had OTs and physios and I thought it was a pretty small class. It was good’ (FG2, Quote 86).

5.1.23.3 **'Gross anatomy classes': Chronological changes in sizes of classes**

Over the years the number of student enrolled in anatomy classes has increased (Zhang, 2017). Comments from two of the FG particpants also illustrated this chronological increase in student numbers:

'If we're on the actual class size. I mean when I did physio I was one of 29. Now the physio class is like 60-70. So I mean the classes…the groups are going to be a lot bigger' (FG 3, Quote 315).

… 'So by the time we got into second year we were 72 physios ONLY that didn't include OTs, pharmacy…nurs…it was crazy!' (FG3, Quote 324).

5.1.23.4 **'Gross anatomy classes': Size of dissection/prosection group and interaction between group members**

As pointed out by Linacre (2005) dissection group dynamics can see one person dominating the group and one or more in a group taking to the sidelines and doing very little or nothing. He also spoke of the 'chatting' aspect of group participation. A participant in this study commented on a similar scenario saying:

'*Ya but the other…the other thing that I pick up when we are studying anatomy especially dissection area …we are in groups so usually the one that know better in one group is the one that's handling everything there (murmurs of agreement from other group members)…but the rest is just standing there and just…you know talking whatever, chatting and something like that. The one that KNOW more is gonna LEARN more at that process and then the other one's just relaxing…' (FG4, Quote 33).*

However, another participant described a much more ordered way of working in the dissection group saying:

'The practicals we also had six in a group but we had to rotate responsibilities so one day you'd have one person dissects, one read, one go through the functions and all of that and then the last person would have to put everything away at the end of the session …um…which we found really helpful because when each of us had to participate in it…'(FG5, Quote 104).

Dissection groups ranged from two to ten students. Today a dissection group of two students would be rare if not impossible to find. Cadaver to student ratios may differ and the number of students per cadaver seems to be increasing chronologically in most cases: 1:4 (Cantor, 2010:180), 1:5 in Kenya (Ongeti, 2012) and 1:8-9 in Australia (Dissabandara et al., 2015). However, Snelling, Sahai and Ellis (2003) in the UK did record a ratio of 10-12 students per cadaver that somewhat bucks the trend.

In South Africa the mean student to cadaver ratio was found recently to be 8(±3,5) and the distribution ranged between 4-6 and 10-12 (Shead et al., 2018). In this study an older participant described the advantages of being a group of two and highlighted that others in the FG group had dissected or observed prosections in bigger groups:

'And I think of everyone I'm the only one who had two rather than six, or eight, or ten…for me that was…um…I would think that we were at a huge advantage 'cos there was no getting away from doing it and doing it properly so if you were dissecting upper limbs each took one and it was only really…sort of middle that we had to share and take turns. So one person would read and the other person would dissect. So it was a very intensive thing and it worked well for me because of the partner I had. I think if you ended up with a dud partner it would have been a bit more challenging' (FG5, 102).

5.1.24 **Theme 6: 'Time is of the Essence'**

The fact that time allocated to anatomy teaching is being whittled away at an alarming rate has already been mentioned in this thesis in Chapter 2 (literature review). This is a global phenomenon (Azer and Eizenberg, 2007; Plaisant, Cabanis and Delmas, 2004; Drake, Lowrie and Prewitt, 2002; Heylings, 2002, Kramer and Soley, 2002; Cottam, 1999; Leong, 1999.

5.1.24.1 **'Time is of the Essence': Time available for course versus pressure on students to learn'**

Anatomy is a subject that requires the student to learn a great deal of information in a short time. To help ease this situation it has been suggested that the addition of new methodology of teaching and the amount of information taught should not be related to a phenomenon termed' curriculum creep" (Evans and Pawlina, 2015: 326). From the FG participant responses it was clear that for some students the time versus pressure to learn debate was not a positive experience:

'I also think…ya…anatomy is…if I think about it is information overload. That's what I think of when I think of anatomy to be quite honest because even with…even with dissection…even if you're not dissecting you're just looking at it…you have to like know it very well and you have to like take in so much information to actually pass' (FG 4,Quote 58).

'The first semester just trying to dissect …just trying to get and keep up to where we were and make sense…'(FG3, Quote 45).

One participant made the point that a lot of information was hurriedly explained in lectures while another found lectures very boring.

'We had like two hours of anatomy a week lectures where in that two hours they'd rush through so much the truth was you couldn't actually pick up any information' (FG4, Quote 28)

'…Very long, tedious with lots of information lectures…that I used to fall asleep in …' (FG5, Quote 20).

5.1.25 Theme 7: Anatomy 'Know How' for Physiotherapy Practice

5.1.25.1 Anatomy 'Know How' for Physiotherapy Practice: Clinical relevancy and anatomy

In a recent study a group of Australian researchers investigated how well PT students remembered the carpal bones in order to establish attrition rates in anatomy learning (Dayal et al., 2017). These researchers pointed to the importance of knowledge of anatomy, understanding of the subject and assessment of attrition rates as anatomy in the early years of the PT programme is the basis for later clinical learning. There is a deficit of knowledge for PT practice when anatomical knowledge is lost. One participant in a private sector group validates the need for a sound anatomical basis for clinical work saying:

'It was only when we started doing clinical work in third and fourth year that…you actually sort of realised the relevance of it' (FG3, Quote 40).

A participant brought up the fact that physiotherapists in South Africa are first line practitioners and linked this to the necessity to have a sound anatomical knowledge of the whole human body. She also elaborated on the fact that physiotherapists do not treat certain conditions but need to be aware of them to refer the patient to the correct clinician for treatment. Others in the same FG agreed and suggested that a PT speciality like visceral manipulation may require this overall anatomical knowledge as well. They said:

'Well you need to cover everything. I mean, even though you live in South Africa, the fact that you're almost. No you are a first line practitioner if you for instance leave out the GIT or anything then you're taking away you know so then you can basically just pick up or diagnose musculoskeletal stuff and not that you can diagnose GIT but you must be able to pick up something that's…' (FG1, Quote 192)…(Interrupting 'Very debatable. May be able to refer on then' (FG1, Quote 193)… 'Or you want to do visceral manipulation one day. Physio is so broad!' (FG1, Quote 194).

5.1.25.2 Anatomy integration into physiotherapy course

Harden and Stamper (1999) discussed the need for designers of a curriculum to ask themselves pertinent questions during that process. One such question pertaining to

an anatomy curricular design might be how clinical material should be introduced into a PT course using vertical integration. Bruner (1960) introduced the idea of a 'spiral curriculum'. Harden and Stamper (1999:141) explained this concept as being 'one in which there is an iterative revisiting of topics, subjects or themes throughout the course'. Hence, this type of curricular design might allow PT students to revisit anatomy during their clinical blocks. Krause, Youdas and Hollman (2011) put forward that integrating anatomy during the entire PT course helps to reinforce previously learnt anatomical material.

In the FGs in this study particpants expressed the wish that they could have revisited anatomy in the later years of their undergraduate PT course saying:

'…Now I'd rather go do a dissection in my third year or my fourth year once I'd actually done the theory and be able to look at it and be okay so when I work here this is what I'm working on and actually imagine it in that way' (FG4, Quote 37).

'Ya. And I also thin… Ya! 'Cos that's what we were speaking about this morning also like if you say doing neuro now in like third year or whatever then to revise the brain and like know exactly how that works' (FG4, Quote 51).

Two good examples of a spiral curriculum approach were given by particpants:

'I will comment that I think what happened with us is we overlapped our biomechanics where we did muscle testing. Which happened to fall in the same section when we were doing like the upper limb and then at that stage the lecturer would be very adamant that when you presented your muscle you'd have to go as fine as possible into the anatomy and then you'd do the surface anatomy on your model and then you'd do your testing so that it was the first time with almost was integrated. It would have been actually nice if you could have done upper limb with module two testing and then maybe lower limb. And then actually when we did the module three we had already passed, we had already done Obliques muscle testing so it didn't really correlate and merge so ya"(FG1, Quote 49).

'It was the year after I did anatomy because our lecturer was very pro anatomy. She used to chase you out the class if she asked you something and you did not know. Very nerve wracking stuff and she…it was very much like a spot on thing where she just asked you randomly and you know you don't know it and you really feel bad so they drummed it into us and you learnt it more as you went along. It became a practical thing as you went along like they're saying to people to incorporate the knowledge practically …using practical examples. That's when it…it made sense' (FG2, Quote 62).

5.1.25.3 **Relevance of surface anatomy knowledge for explanation of structures to patient**

One participant in the private sector pilot study FG 1 related a clinical scenario where the importance of her anatomical knowledge and ability to use surface anatomy knowledge in particular was extremely useful. It enabled her to assist her patient not only to visualise where his first rib was but instilled confidence regarding her competence as a PT practitioner. A patient and caring attitude towards the patient, obvious knowledge of the condition being treated, supportive and compassionate attitude, having accountability and being credible and having good communication with the patient is included in the list of ten qualities pertaining to being a successful physiotherapist (Porter, 2016).

'The other day I was working with a quadriplegic patient of mine and his first rib was really, really sensitive. He was complaining of a lot of cervical pain and that sort of thing and he said "What are you doing?" and I said " I'm…I'm mobilising your first rib" "My first rib? It's not there" (Laughter in the group) And I rushed off to get my anatomy book and I show him where it is and "Oh!" '" You know but it's that sort of thing I mean you need to know those, those sort of, where to find the first rib and where to you know and what are all the …so I think …yea …it's a very good thing I did surface anatomy' (FG1, Quote 219).

5.1.25.4 **Identification of a possible 'physiotherapist personality'**

During the FGs an interesting consideration arose and this was the identification of a possible physiotherapist's personality type. Another of the identified personality traits that Porter (2016) listed is to be well organized and the following FG quote, although specific to anatomy education, illustrates this well:

'I think…um…especially with like physios we tend to …or not to (sighs) .I generalise but I think we tend to be like…our personalities are very like…we're structured people. We like lists and this and that and show me what to do and how to do it and I can do it. You know…um…so also with anatomy…show me and…you know…and I'll be able to do it but don't sit there and lecture me and you know …this and that and here and there…it should be like this. We're doing the arm now…okay great …like this and then you go and look at the arm and we can sort of tick our lists…' (FG4, Quote 45).

5.1.26 **Conclusion**

It can be seen that the FG discussions raised and encompassed a vast array of matters pertaining to the teaching of a gross anatomy curriculum to undergraduate PT students. The attainment of theoretical saturation in categories and the

identification of seven main themes enabled a composite picture of the topic to be attained. The basic information pertaining to course content, pedagogy, assessment format, class size, IPE and other learning strategies and staff compliment was documented. However, other matters came to light such as the effect of dissection (or prosection) on the student psyche and coping mechanisms applied by students to address such a stress in their lives, the weight of 'anatomy information overload' and identification of a possible PT personality type. The information gleaned by the FG process offers further insight into the entire pedagogy and curriculum requirements for a gross anatomy course for undergraduate PT students. Study 3 has verified the use of certain pedagogy and teaching strategies for this student population and enabled a clearer vision of what are necessary inclusions in a unified gross anatomy curriculum for South African PT students and by so doing has contributed to the required overall outcome of this thesis as defined in Chapter 1.

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LINKING NOTES BETWEEN CHAPTERS 3, 4 AND 5 (PAPERS 2 AND 3 AND STUDY 3)

This section contains information to clarify the link between Chapters 3, 4 and 5 (Papers 2, and 3 and Study 3). An in depth discussion of the findings of each individual paper and Study 3 is presented in the discussion sections of the papers and study respectively. An overall discussion of the thesis can be found in Chapter 7.

It can be seen in Papers 2 and 3 of this thesis that gross anatomy education for undergraduate PT students, both globally and nationally, incorporates many different aspects relating to curriculum and teaching methods used. The fact that PT students are preparing for a clinical future has to be considered in relation to curricular content. If the content is not pertinent to future PT career requirements it falls short of its purpose. The question is therefore raised as to who would be best suited to assist with suggestions as to how to taper the PT gross anatomy programme in keeping with those clinical ideals.

Study 3 garnered the opinions of qualified South African physiotherapists, in three different service delivery sectors, with regard to gross anatomy curricula and pedagogical consideratons for undergraduate PT students in the country. Logically, it is those PT practitioners that are currently treating patients or teaching future physiotherapists that will have the most up-to-date opinions on curricular inclusions and the best way of delivery of such a curriculum to undergraduate PT students. They are aware of the patients' clinical needs that the PT students' will be required to treat on graduation. They also know the teaching methods that were most beneficial to their anatomy knowledge retention. Therefore, the input from these particpants gave valuable insight into the clinical relevancy of curricular inclusions and pedagogy used to teach the subject.

Much of what was raised in the FG discussions reiterrated information in Papers 2 and 3 of this thesis and reinforced traditional teaching methodology, in particular. Focus group participants did not raise computer technology as a predominant pedagogy and were inclined to look upon it as an adjunct to the traditional teaching methodology. The concept of blended learning did not dominate the discussions. These opinions talk to the fact that it was reported in Paper 3 that fifty per cent of South African faculties have shortages in computer technology.

Overall, the addition of the qualitative research perspective on the main topic offered a personal and pertinent perspective on the clinical reasoning behind curricular and

pedagogical choices in order to design a targeted gross anatomy programme to meet the needs of the undergraduate PT student body.

Chapter 6 (Paper 4) follows and is an assessment of the gross anatomy learning styles of the 2015 and 2016 PT student cohorts at WITS (using the GRLSS) and compares those styles with the teaching styles of their gross anatomy lecturers in both years (using the GRTSS).

CHAPTER 6

6.1 ORIGINAL PAPER 4

Shead DA, Roos R, Olivier B, Ihunwo AO 2018 Learning Styles of Physiotherapy Students and Teaching Styles of their Lecturers in Undergraduate Gross Anatomy Education. ***African Journal of Health Professions Education (in press).***

Journal: African Journal of Health Professions Education

Journal Details: The African Journal of Health Professions Education is an online, peer-reviewed journal that publish manuscripts related to health science education. The journal is Department of Higher Education and Training (DHET) accredited.

The formatting of the content of this thesis paper is aligned with the publication requirements of the specific journal. The tables and figures have been inserted at the appropriate position in the paper and are numbered in accordance with the formatting of this thesis document.

6.2 ORIGINAL PAPER 4

6.2.1 Title: Learning styles of physiotherapy students and teaching styles of their lecturers in undergraduate gross anatomy education.

Authors: Shead DA, Roos R, Olivier B, Ihunwo AO

6.2.2 Abstract:

Background

Anatomy is essential to prepare physiotherapy students for future clinical practice. Student learning styles and lecturer teaching styles may influence learning outcomes.

Objectives

To determine if learning styles of this student population were consistent and compatible with lecturers' teaching styles for better learning outcomes.

Methods

A descriptive cross-sectional study was done during 2015 and 2016. Grasha-Riechmann Learning Styles Scale (GRLSS) and Grasha-Riechmann Teaching Style Scale (GRTSS) were used to measure learning styles of two consecutive physiotherapy student cohorts and teaching styles of their anatomy lecturers, respectively.

Results

Student samples were small (Group 1, n=59 and Group 2, n=54) but response rates high (n=39, 66.1% and n= 43, 81.5%) in 2015 and 2016. Mean Likert scores for GRLSS indicated most popular choice for learning style was the Dependent style: 3.81(0.75) for Group 1 and the Independent style: 3.68(0.61) for Group 2. Female students preferred the Dependent style (Group 1: n=12, 30.8%, Group 2: n=10, 23.3%) and male students the Participant style (Group 2: n=6, 14%) of learning. Lecturers scored highest in the Expert category of teaching styles. Compatibility between learning and teaching styles was seen in both years based on comparisons made using teaching style clusters where the identified GRLSS and GRTSS styles were grouped together and were seen to fit into specific cluster categories.

Conclusion

Consistency in learning style choice was observed. A degree of cohesion between 2015 and 2016 students learning styles and their respective lecturers' teaching styles augured well for good interaction between staff and students.

Keywords:

Gross anatomy education, undergraduate education, physical therapy education, physiotherapy education, student learning styles, allied health.

6.2.3 Introduction

Anatomical knowledge is essential to the competency of physiotherapists in professional practice. [1] Therefore, how physiotherapy students learn gross anatomy has a bearing on their clinical acumen.

An abundance of literature on learning style models has been promulgated from the 1960's to date. Diverse opinion as to the value of learning style research is apparent. Early researchers were positively disposed to the idea of the educational value of knowing learning styles [2-4] and some still uphold that belief [5]. Recent researchers are more sceptical about the scientific value in enhancing student academic performance and facilitating better teaching methodology in general [6,7] and in anatomy education in particular. [8]

In 1978 Claxton and Ralston [2] summed up a learning style as " a student's consistent way of responding and using stimuli in the context of learning". Grasha and Yangarber-Hicks [9] found that some learning styles are more dominant than others and some are only utilised if sufficient reason and support is given.[10] It was found that the subject to be learnt could influence learning style preference [11] and health science students showed a bias towards a particular learning style preference. [9,]

In 1987 Curry [12] described a learning style model depicted by an onion-like structure with four layers. These are from outside to innermost the ‘instructional preference’, ‘social interaction’, ‘information processing style’ and ‘cognitive personality style’ layers. The Grasha-Riechmann learning style scale (GRLSS) was placed in the ‘social interaction’ layer of that model and was aligned with the expectations of teachers and students and their interaction with the learning environment as is the case in this study. [3,11,12] Criteria that guided the choice of the GRLSS and GRTSS tools for data collection in this study were that the GRLSS was designed to collect information from university students [4,13] and it exhibits compatibility with the GRTSS and so facilitates easy comparisons to be made between the two tools. The GRLSS has not been specifically negatively critiqued in the literature for its learning style preference stance.

This study forms part of a thesis investigating various aspects of gross anatomy education for undergraduate physiotherapy students and as such sought to identify any learning style preference trend peculiar to physiotherapy students and document the teaching styles of two consecutive cohorts of gross anatomy lecturers. The realisation that there was a paucity of specific pertinent information on these aspects of gross anatomy education necessitated the collection of the data in this study. It has been shown that age and gender significantly influences student learning style preference. [14] This study aimed to assess how age and gender influenced the learning style preferences of two chronologically consecutive student cohorts. All the information collected will be factored into the thesis and will add to the body of literature pertaining to the on going debate on the relevancy of using learning and teaching style measurement tools.

6.2.4 **Methods**

A descriptive cross-sectional design was used for this study with purposive sampling. The students invited to participate in the study were the second year physiotherapy students in the gross anatomy classes, of 2015 (student Group 1)(N=59) and 2016 (student Group 2)(N=54). The invited gross anatomy lecturers who taught the students gross anatomy were designated lecturer Group 1 (N=5) and lecturer Group 2 (N=4). Ethical clearance was obtained from the Human Research Ethics Committee (H15/04/12) of the University of the Witwatersrand Johannesburg, South Africa Permissions were obtained from the University’s Dean of Student Affairs and the Head of the Department of Physiotherapy to administer the survey to the student body. The standardised 60-question version of the GRLSS [13] was administered to the student groups in September 2015 and late August 2016. To maintain

confidentiality of participants the GRLSS and demographic questionnaires were distributed and collected by the respective class representatives. No identifiers were on the answer sheets. Permission was obtained from the Head of the School of Anatomical Sciences prior to distribution of the GRTSS to the lecturer groups. The standardised 40-question version of the GRTSS [15] was distributed to and collected from the lecturer groups by the gross anatomy course coordinator for physiotherapy students. The timing of this distribution was aligned with that of the GRLSS to the student groups.

The standardised GRLSS [4,13] administered to the student groups was evaluated for reliability by Baykul et al. [16] and the authors of that paper found the co-efficient scores for the six sub-categories were medium. Internal consistency of each subscale was found to be acceptable and suitable for measuring interactive learning styles. [16] The scoring sheet for the GRLSS includes information on learning style preference norm values according to specified age groups. [4] These norms were formulated using Grasha's [15] own research into learning styles where he defined low, moderate and high 'cut-points' for learning styles. He also defined the same levels for his GRTSS scale. [15] The development of teaching style clusters by Grasha [15] allowed for the matching of student learning style preferences with teaching style preferences for optimum transfer of knowledge from teacher to students. Data pertaining to validity or reliability of the GRTSS tool administered to the lecturers in the current study could not be found during a literature search. A five point Likert scale was used to score both scales. The sum of the scores in each category was divided to produce an overall score to one decimal place. Mean and (SD) calculations were presented to two decimal places.

Descriptive data analysis was done using IBM SPSS 24 statistical package (Version 24.0 Armonk, NY: IBM Corp, 2016). Missing data were not replaced and therefore not included in the analysis. The 2015 and 2016 student cohorts' GRLSS data analysis results, including descriptive findings are presented as means (SD), frequencies and percentages (Table 6.1). Results of Pearson's correlation coefficient and paired t tests at $P < 0.05$ comparing group means for differences and correlations between student Groups 1 and 2, student Group 1 and the GRLSS norms and student Group 2 and the GRLSS norms are presented (Table 6.2). Calculations for the 17-21 years and 22-28 years age groups were carried out separately as the GRLSS norms for each age group differed.

Figures 6.1 and 6.2 illustrate comparison of group means for each learning style by age category and their comparison to the associated GRLSS norms. A graph (Fig. 6.3) shows the relationship between gender and student learning style preference for student Groups 1 and 2.

The GRTSS rankings for teaching style choices made by both lecturer groups were calculated and tabulated as means (SD) values (Table 6.3). Data analysis was undertaken to establish prevalent teaching styles and cluster categorization of the two teaching cohorts for comparison with the student learning style preferences identified in each year studied.

6.2.5 Results

Participants

In 2015 the student group consisted of 59 students and 39 (66.1%) completed the GRLSS. In 2016 the student group consisted of 54 students and 43 (81.5%) completed the GRLSS. Five lecturers taught the students in 2015 and all completed the GRTSS. In 2016 four lecturers taught the students and three (75%) participated in the study.

Table 6.1 provides information regarding the demographic profile of student participants. The majority of students were 20 years of age: Group 1 (n=18, 46.2%), Group 2 (n=22, 51.2%). In both groups the number of female students was greater than male students: Group 1 females (n=32, 82.1%) and males (n=7, 17.9%), Group 2 females (n=33, 76.7%) and males (n=10, 23.3%). Predominant pre-university education was private in Group 1 (n=24, 61.5%) and government in Group 2 (n=23, 53.5%).

Learning style choices of student groups

Table 6.1 provides information regarding the learning styles of the student participants. Overall the most popular learning style choice for student Group 1 was the Dependent style 3.81(0.75) and for student Group 2 the Independent style 3.68 (0.61). A student who chooses the Dependent style is said to be passive, needs structure and constant support. [4] A student who chooses the Independent style learning option is said to be a person who is individualistic, confident and acts alone. [4] The younger age group (17-21 years) results in both cohorts differ little from the overall results.

Table 6.1: Comparison of Demographic Information for Student Group1 and Student Group 2

Demographics	Student Group 1		Student Group 2	
Age n (%) 19 years 20 years 21 years 22 years 23 years 24 years	 4 (10.2%) 18 (46.2%) 14 (35.9%) 1 (2.6%) 1 (2.6%) 1 (2.6%)		 10 (23.3%) 22 (51.2%) 8 (18.6%) 1 (2.3%) 1 (2.3%) 1 (2.3%)	
Gender n (%) Male Female	 7 (17.9%) 32 (82.1%)		 10 (23.3%) 33 (76.7%)	
Type of school n (%) 1.Government 2.Private	 15 (38.5%) 24 (61.5%)		 23 (53.5%) 20 (46.5%)	
Learning style rankings in descending order Mean (SD)	1. Dependent 3.81(0.75) 2. Collaborative 3.65(0.56) 3. Participant 3.52(0.53) 4. Independent 3.49(0.64) 5. Avoidant 2.78(0.44) 6. Competitive 2.42(0.67)		1. Independent 3.68(0.61) 2. Dependent 3.67(0.86) 3. Collaborative 3.63(0.50) 4. Participant 3.63(0.48) 5. Avoidant 2.91(0.42) 6. Competitive 2.20(0.61)	
Learning styles chosen by age group listed in descending order Mean (SD)	(17-21 years) n=35 1. Dependent 3.84(0.43) 2. Collaborative 3.69(0.45) 3. Participant 3.51(0.51) 4. Independent 3.48(0.41) 5. Avoidant 2.82(0.59) 6. Competitive 2.51(0.74)	(22-28 years) n=3 1. Participant 3.67(0.49) 2. Dependent 3.57(0.25) 3. Independent 3.53(0.31) 4.Collaborative 3.13(0.45) 5.Competitive 2.47(0.25) 6.Avoidant 2.37(0.59)	(17-21 years) n=40 1.Independent 3.68(0.34) 2.Collaborative 3.67(0.53) 3.Dependent 3.66(0.46) 4.Participant 3.63(0.57) 5.Avoidant 2.90(0.61) 6.Competitive 2.19(0.71)	(22-28 years) n=3 1.Dependent 3.83(0.40) 2.Independent 3.67(0.47) 3.Participant 3.53(0.38) 4.Collaborative 3.17(0.32) 5.Avoidant 3.00(0.70) 6.Competitive 2.33(1.19)

SD: Standard deviation

The least favoured learning style choices overall were Avoidant (Group 1: 2.78(0.67), Group 2: 2.91(0.42) and Competitive (Group 1: 2.42(0.67), Group 2: 2.20(0.61) categories. Avoidant style students are unenthusiastic and disinterested. [4] Competitive style students like to outshine others, be recognized and get rewarded. [4] As can be seen in Table 6.1 the top four ranked learning styles were the same in both years but their order varied

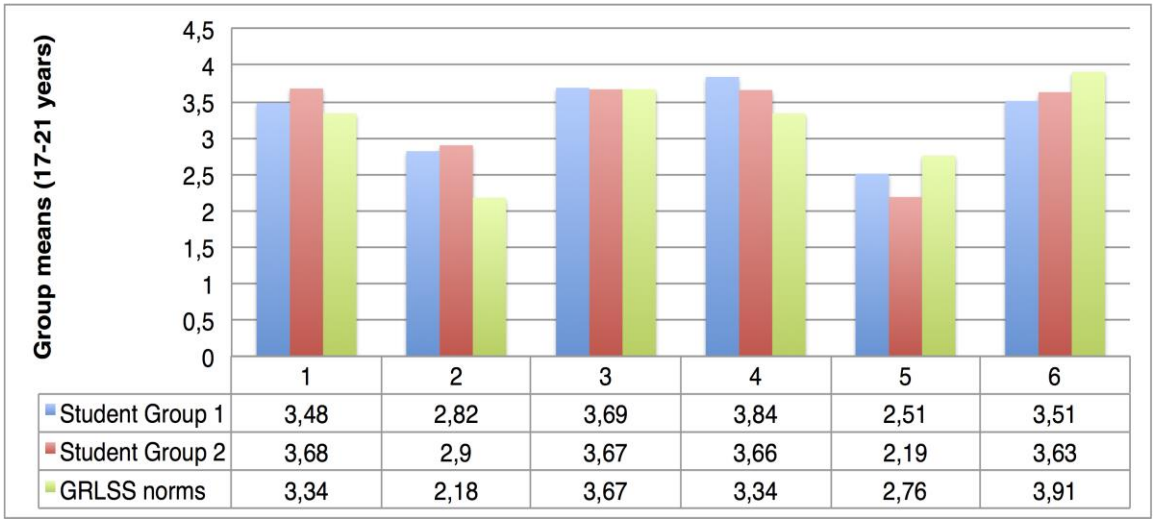
Table 6.2: Comparison of Means for Combined Grasha-Riechmann Learning Style Scale (GRLSS) Score Differences and Correlations between Student Groups 1 and 2 and GRLSS Norms

Group pairs	Mean Difference (SD)	95% CI lower, upper	t–value	df	P-value (2-tailed)	Correlation	P-value
Pair 1: Student Group 1 and student Group 2 (17-21 years)	0.02 (0.20)	-0.19, 0.23	0.249	5	0.813	0.954	0.003**
Pair 2: Student Group 1 and GRLSS norms (17-21 years)	0.11 (0.41)	-0.32, 0.54	0.651	5	0.544	0.767	0.075
Pair 3: Student Group 2 and GRLSS norms (17-21 years)	-0.09 (0.47)	-0.58, 0.40	-0.463	5	0.663	0.721	0.106
Pair 4: Student Group 1 and student Group 2 (22-28 years)	-0.13 (0.29)	-0.44, 0.17	-1.112	5	0.317	0.868	0.025*
Pair 5: Student Group 1 and GRLSS norms (22-28 years)	0.07 (0.64)	-0.60, 0.74	-0.403	5	0.704	0.865	0.026*
Pair 6: Student Group 2 and GRLSS norms (22-28 years)	-0.06 (0.39)	-0.47, 0.34	0.263	5	0.803	0.560	0.247

SD: Standard deviation, df: degrees of freedom * $p < 0.05$, **$p < 0.01$

Comparison of learning styles mean score differences and correlations between student Groups 1 and 2 and GRLSS norms

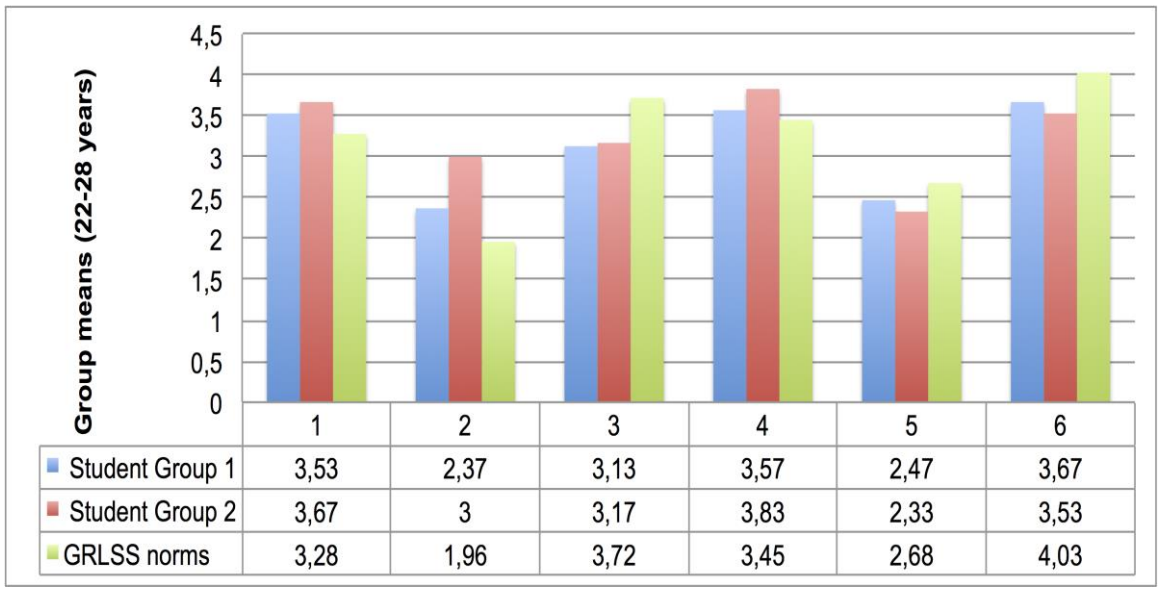
The group means for all six learning styles were calculated. A comparison of learning style means for Groups 1 and 2 and the GRLSS norms by student age category can be seen in Figures 1 and 2. There is little parity between the GRLSS norms and the scores attained in this study except in the 17-21 years Collaborative category. Collaborative style students are keen group participants and like to share ideas. [4]



	1	2	3	4	5	6
Student Group 1	3,48	2,82	3,69	3,84	2,51	3,51
Student Group 2	3,68	2,9	3,67	3,66	2,19	3,63
GRLSS norms	3,34	2,18	3,67	3,34	2,76	3,91

Figure 6.1: Comparison of Group Means for Grasha-Riechmann Learning Styles (17-21 years) and Grasha-Riechmann Norms (GR norms) for this Age Group

1:Independent, 2: Avoidant, 3:Collaborative, 4:Dependent, 5:Competitive, 6:Participant



	1	2	3	4	5	6
Student Group 1	3,53	2,37	3,13	3,57	2,47	3,67
Student Group 2	3,67	3	3,17	3,83	2,33	3,53
GRLSS norms	3,28	1,96	3,72	3,45	2,68	4,03

Figure 6.2: Comparison of Group means for Grasha-Riechmann Learning Styles (22-28 years) and Grasha-Riechmann Norms (GR norms) for this Age Group

1:Independent, 2: Avoidant, 3:Collaborative, 4: Dependent, 5:Competitive, 6:Participant

Table 6.2 illustrates that a statistically significant strong Pearson's correlation was found between the set of learning style means for student Groups 1 and 2 (Pair 1) in the 17-21 years age group (r= 0.95, P<0.003). A significant but weaker correlation between learning style means occurred between student groups in the 22-28 years category (Pair 4) (r=0.86, P<0.03). Paired t-tests showed that there was not a significant difference in overall GRLSS scores (17-21 years) for Group 1: 3.3 (0.52), Group 2: 3.3(0.62) at 0.02 (95%CI, -0.19 to 0.23), t (5) = 0.249, P = 0.813 nor a significant difference in overall GRLSS scores (22-28 years) for Group 1: 3.1(0.58), Group 2: 3.3(0.55) at -0.13 (95%CI, -0.44 to 0.17), t (5) =-1.112, P= 0.317. The null hypothesis (H_o) put forward was that the GRLSS choices of PT students in sequential cohorts would be significantly similar. The overall paired t-test results were in agreement with the $H_{0.}$ The correlation between student Group 1 (22-28 years) and the GRLSS norms was significant (r= 0.87, P< 0.03I).

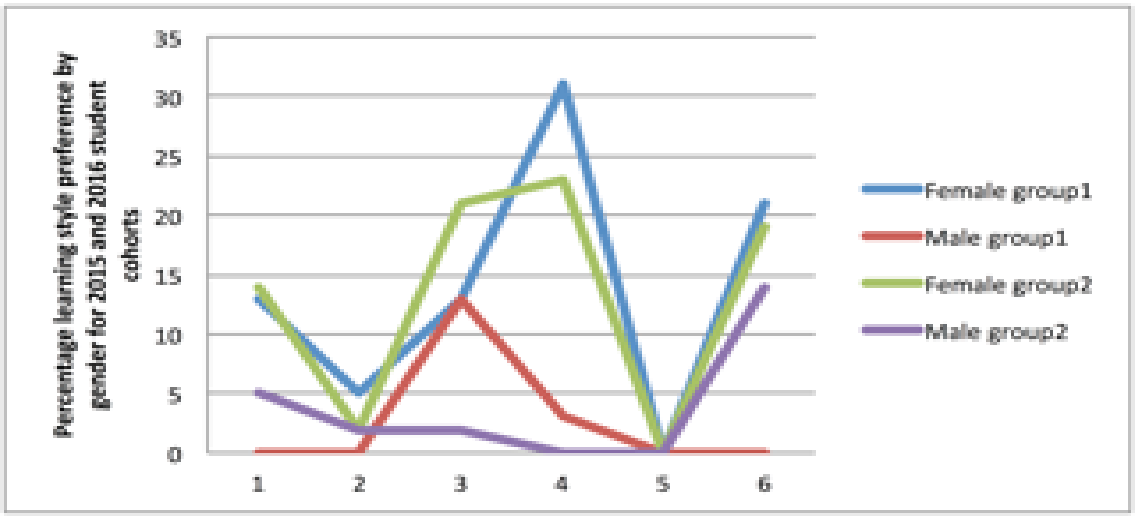


Figure 6.3: Distribution of Learning Styles (1-6), by Gender, for Student Groups 1 (2015) and 2 (2016) Results are Inclusive of Age Groups (17-21 years) and (22-28 years)

1: Independent, 2: Avoidant, 3: Collaborative, 4: Dependent, 5: Competitive, 6: Participant

The distribution of learning styles by gender

Figure 6.3 illustrates the percentage of students who preferred each learning style by gender across the two cohorts. It showed that female students had a high preference for the Dependent learning style over both years with Group 1 (n=12, 30.8%) and Group 2 (n=10, 23.3%). Male students showed little or no preference for this style. An equal number of female students favoured the Participant learning style in Group 1(n=8, 20.5%) and Group 2(n=8, 18.6%) and the majority of male participants in Group 2 (n=6, 14.0%) also preferred this style. Participant style students complete coursework, take part in activities and work well with others. [4] Male and female students in Group 1 (n=5, 12.8%) equally favoured the Collaborative style but differences occurred in Group 2 as (n=9, 20.9%) female participants and only (n=2, 5.0%) male participants preferred it. The Independent learning style was popular with female Group 1 (n=5, 12.8%), Group 2 students (n=6, 14%) and male Group 2 students (n=2, 4.7%).

Teaching styles of anatomy lecturers

The mean age for lecturer Group 1 was 33.8 (1.64) years and the ratio of males to females was 3:2. The mean age for lecturer Group 2 was 33.7 (0.58) years and the ratio of males to females was 1:2. In 2015, out of a total of 5 respondents, one lecturer had a PhD (20%) and the others masters degrees (n=4, 80%). In 2016, out of a total of three respondents, two lecturers had PhDs (66.7%) and one a master's degree (33.3%). All lecturer group 2 respondents had previously responded to the GRTSS in 2015 as they were also teaching the students in 2015.

Table 6.3 records the lecturers' teaching style preferences based on a five-point Likert scale allocation. Although mean (SD) scores may be higher in a category than in another category the ratings from 'low' to 'high' are based on a comparison with mean scores found by Grasha as reported by Alami and Ivaturi. [17] A 'high' rating denotes preference for that teaching style by a respondent. More than one teaching style can be rated highly within a group. Respondents in both groups scored highest for the Expert category where the teacher offers detailed and expert coverage of the work and challenges students to achieve. [15]

Grasha described four type of teaching style clusters [15]. Scores rated from highest to lowest for the different style categories on either the GRLSS or the GRTSS determined into which cluster the teacher and student should be placed. Table 3 shows that for lecturer Group 1 the expert-formal authority-and personal models had

the highest rating overall. Lecturer Group 2 showed highest teaching style preferences for expert-personal model, facilitator and delegator categories.

Table 6.3: Teaching Style Scores of Anatomy Lecturer Groups 1 and 2

Teaching style	Respondent group	Group Mean (SD)	Mean scores of individual respondents (R)	Rating level
Expert	Lecturer Group 1	3.96 (0.47)	R1= 3.8 R2= 4.3 R3= 4.2 R4= 4.3 R5= 3.2	High High High High Moderate
	Lecturer Group 2	4.37 (0.40)	R1= 4.0 R2= 4.8 R3= 4.3	High High High
Formal authority	Lecturer Group 1	3.52 (0.32)	R1= 3.0 R2= 4.0 R3= 4.3 R4= 2.6 R5= 3.7	Moderate High High Moderate High
	Lecturer Group 2	3.37 (0.76)	R1= 3.2 R2= 4.2 R3= 2.7	Moderate High Moderate
Personal model	Lecturer Group 1	3.56 (0.46)	R1= 3.3 R2= 4.3 R3= 3.1 R4= 3.3 R5= 3.6	Moderate High Moderate Moderate High
	Lecturer Group 2	3.70 (0.98)	R1= 4.0 R2= 4.5 R3= 2.6	High High Low
Facilitator	Lecturer Group 1	3.43 (0.53)	R1= 4.0 R2= 3.7 R3= 3.2 R4= 2.9 R5= 2.8	Moderate Moderate Moderate Low Low
	Lecturer Group 2	3.87 (0.51)	R1= 4.3 R2= 4.0 R3= 3.3	High High Moderate
Delegator	Lecturer Group 1	2.68 (0.39)	R1= 2.7 R2= 3.0 R3= 2.5 R4= 2.4 R5= 2.2	Moderate High Moderate Moderate Moderate
	Lecturer Group 2	3.05 (0.07)	R1= 3.1 R2= 3.0 R3 =2.1	High High Moderate

SD: Standard deviation

Cluster 1:

Student learning Styles: Participant–Competitive-Dependent.

Teaching styles: Formal Authority-Expert.

Cluster 2:

Learning styles: Collaborative-Participant-Dependent.

Teaching styles: Formal Authority- Personal Model-Expert.

Cluster3:

Learning styles: Independent- Participant-Collaborative.

Teaching styles: Expert-Facilitator-Personal Model.

Cluster 4:

Learning styles: Participant-Collaborative-Independent.

Teaching styles: Expert-Delegator-Facilitator.

In lecturer Group 1 three respondents (60%) fell into the Grasha Cluster 2 and one (20%) into Clusters 1and 4 respectively. In lecturer Group 2 one respondent (33.3%) fell into Cluster 2 and two into Cluster 4.

Using the cluster combinations listed above it was seen that in 2015 where the top three ranked learning styles chosen were Dependent, Participant and Collaborative the most appropriate teaching style cluster would be Cluster 2. In that year 60% of the lecturers subscribed to Cluster 2. Other lecturers were in Clusters 1 and 4 and would be able to relate to two out of three of the most preferred learning styles. In 2016 the top three ranked learning styles were Independent, Dependent and Collaborative. It was apparent that one of the 2016 lecturer participants had 'accommodated' from cluster 1 or 2 to cluster 4. This move meant that two of the lecturers had now aligned themselves with the teaching styles represented in Cluster 4 and therefore would facilitate and delegate in their teaching methodology. This would be more in line with the more independently orientated student Group 2.

6.2.6 **Discussion**

In the overall scenario age did influence student learning style preferences. Marked preferential differences were seen between the 17-21 year age cohorts and the related 22-28 year cohorts. A comparison of the two groups' means for 2015 and 2016 showed more compatibility (50%) between the younger age groups than the older age groups (17%). Life experience and environmental factors may have influenced diversity in older students' thinking. [18] Overall student participants were 'millennials' from generation Y born between 1982 and 2003 and this may have played a part in age-related learning style preference. Coates [19] describes the children of the millennial generation as being mollycoddled by their parents and unable to make decisions or manage conflict. Hence, these students possibly lack independence and are more suited to the Grasha Dependent style category seen to dominate learning style preference in the 2015 student cohort. The 2016 student cohort's preference for the independent learning style may appear to contradict this

assumption but consideration should be given to the fact that the result was a marginal one with the dependent style ranked as a close second preference.

Gender has been shown to influence learning style preference. [20] Gender considerations impacted results in this study with some clear differences between male and female learning style preferences indicated. While both female student cohorts clearly ranked the Dependent learning style highly male students did not. Furthermore, the predominantly female nature of both student cohorts skewed the overall learning style preference towards the Dependent category especially in 2015. However, this may not be a problematic situation as Kulac et al [21] found that female medical students preferring the Dependent style scored higher than male counterparts on examinations. Unpopularity of the Avoidant and Competitive categories was seen across all genders in both cohorts and this could be considered a similarity between gender preferences. Using the Participant, Collaborative and Independent learning style markers for guidance most gender style preference alignment was in the Collaborative category in 2015 but in the Participant category in 2016. The Collaborative category is associated with the desired deep learning approach that produces better academic results. [20] Hence, the prominence of the selection of the Collaborative learning style in both female groups and male Group 1 may augur well for beneficial outcomes in these groups.

It has also been postulated that different learning styles pertain to specific student groups. [10,15] Based on the evidence the learning styles of medically orientated student bodies appear to coalesce and are dissimilar to other student group preferences. [16] This study aimed to assess whether physiotherapy students favoured particular learning styles and it was shown that while the order of preference differed over the two years there was consistency in the first four listed preferences. Furthermore, the Collaborative category was similarly selected according to mean scores for both years. However, in order to address the diversity of learning styles possible in student groups more accurate diagnostics may be achieved from more than one learning style instrument being used in this type of research. [22]

The 2015 and 2016 GRTSS survey results showed characteristic cluster groupings of lecturers' styles. [15] It can be challenging for lecturers to match learning styles of specific student populations to teaching styles to ensure clinical readiness. [23] In 2011, King [24] stated that the teaching/learning process is less effective if cohesion between the teaching style of the teacher and learning style of the student is not present. Furthermore, anxiety levels are lowered and the degree of learning and

teaching satisfaction are increased when the learning styles of students and the teaching styles of staff are matched appropriately. [12] This study's results showed a degree of cohesion between the learning styles of two student cohorts surveyed in 2015 and 2016 and the respective teaching styles of their lecturers. This is in line with Grasha's suggestion that teachers vary their teaching style to accommodate the multiplicity of student learning styles as such compatibility would augur well for establishing a future sustained learning environment. [15]

With regard to the strengths of the study, although the study samples were small and limited to the same institution, data were collected from two sequential student and staff cohorts. The significantly strong positive correlation of results between samples for 17-21 years and 22-28 years meant the two samples could be pooled leading to more valid and reliable conclusions being made. There was a high response rate for the student cohorts each year. Lecturer groups were small and the response was not favourable in 2016. However, it was apparent that one 2016 respondent who had also participated in 2015 'accommodated' to a different teaching style cluster more in line with student Group 2's learning requirements adding a new dimension to the results. A weakness was that there was a paucity of information in the literature for comparison of GRLSS findings on the student groups' learning styles and so comparisons had to be drawn with studies using other learning style instruments for data collection. This process was akin to matching 'apples' with 'pears' an unsatisfactory situation. Furthermore, since the data were collected for this study the movement debating the learning style 'myth' has gathered momentum with researchers noting that moves towards 'debunking' such data collection are not necessarily effective but suggesting there should be a move towards the promotion of evidence-based research in its place. [25]

6.2.7 **Conclusions**

This study gives an insight into possible learning styles of physiotherapy students as applied to the anatomy scenario. It is therefore useful for the lecturers involved in gross anatomy education of this student population to consider the outcomes in order to perhaps adapt their teaching styles to facilitate beneficial outcomes for their physiotherapy students. However, the question remains whether this study is sufficient to evaluate the learning styles of physiotherapy students in anatomy definitively generally and in particular in relation to age and gender considerations. A larger longitudinal study may provide answers to this question and give new direction to gross anatomy learning for this student population. However, the debate as to whether continued use of learning styles instruments is valid is on going and although

this study did produce some plausible findings consideration has to be given to conducting the suggested longitudinal research using more verifiable evidence–based research methodology.

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The identification of the learning styles of South African PT students can help with curricular and pedagogical choices best suited to their learning needs. Therefore, this study is pertinent to the requited overall outcome of this thesis as described in Chapter 1.

LINKING NOTES BETWEEN CHAPTERS 2,3,4,5 AND 6 (THE LITERATURE REVIEW, PAPERS 1,2,3,4 AND STUDY 3)

This section contains information to clarify the link between Chapters 2, 3, 4, 5 and 6 (Papers 1, 2, 3, 4 and Study 3). An in depth discussion of the findings of each individual paper and Study 3 is presented in the discussion sections of the papers and study respectively. An overall discussion of the thesis can be found in Chapter 7.

In the literature review (Chapter 2) a synopsis of learning style models used in the collection of data in the allied health sphere and measurement tools was given. This also acted as an introduction to the GRLSS and GRTSS that was used to collect data for Paper 4 (Chapter 6).

Chapters 3,4 and 5 (Papers 1,2 and 3 and Study 3) gave insight into the many pedagogies and learning programmes that PT students use while learning gross anatomy. The PT preferred learning styles identified in Paper 4 (Chapter 6) can be factored together with the different teaching methods available and some conclusions can be drawn as to which type of learning modalities will help students to understand and retain anatomy knowledge optimally. The preferred teaching styles of the gross anatomy lecturers can also be compared with pedagogy and learning programmes offered to the students to enable lecturers to use methods that best fit their style of teaching. The Grasha teaching style clusters, as presented in Chapter 5 (Study 3) also enable lecturers to guage whether they need to adapt their teaching style to accommodate the needs of the student body that they are teaching.

Chapter 7 follows and is a discussion of the findings of the literature review, papers 1,2,3 and 4 and Study 3 in order to gain an overall viewpoint on the state of gross anatomy education for undergraduate PT students in South Africa. This chapter will also enable conclusions to be drawn in Chapter 8 regarding recommendations for a unified gross anatomy curriculum and pedagogy for the PT student body in this country.

CHAPTER 7

7. DISCUSSION

7.1 INTRODUCTION TO THE DISCUSSION

Chapter 7 presents an overall discussion of the implications and significance of the findings presented in Chapters 3 to 6 in relationship to those found in the literature review (Chapter 2). Four original papers and one study relating to factors to be considered when designing a curriculum for and pedagogy to teach a gross anatomy programme were included in this thesis.

The first two papers related to the methodology of and the systematic carrying out of a scoping review of the available literature on the topic of gross anatomy curricular factors and pedagogy used to teach undergraduate PT students an anatomy programme. Due to the fact that there was a paucity of information in the literature pertaining to gross anatomy specifically for the afore-mentioned PT student body the literature review was inclusive of matters pertaining to gross anatomy education for medical students and allied professionals as well.

Paper 3 definitively reported on the state of gross anatomy education for the PT student body in South Africa and this enabled some comparisons to be drawn between its findings, the global scoping review's results and the other literature presented in the literature review chapter. This allowed for comparisons to be drawn between many geographical gross anatomy scenarios.

The clinical viewpoint on the topic of this thesis was provided by FG discussions with professional physiotherapists as described in Study 3 (Chapter 5). The group discussions gave depth to thet. The qualitative element added a new dimension and gave a 'voice' to those in the best position to give insight into the relevancy of gross anatomy content, methodology and organisation to provide undergraduate PT students with the necessary background and foundation for clinical competency. The findings of this part of the thesis provided a platform for comparison with similar information suggested by physiotherapists in the literature review and Papers 1, 2 and 3.

Paper 4 (Chapter 6) determined the learning styles of two consecutive cohorts of PT students and formulated an opinion regarding how these styles might relate to their learning of gross anatomy. When viewed together with the teaching styles of their respective lecturers it was established that cohesion between the lecturer and student

groups could lead to better learning outcomes. It also identified the fact that there is growing momentum in the movement to discredit the use of learning style instruments based on lack of scientific evidence for their use. This aspect of discovery of new views on these measuring tools was factored into the research.

This discussion presents an argument pertaining to the use of mixed methods type of data collection for this thesis. It also presents an overview of matters considered and debated within each original paper and Study 3. Schematicaly in a series of Figures 7.1-7.8 it represents aspects of gross anatomy curriculum or pedagogy identified through the course of this thesis. A more detailed discussion of individual aspects of the research can be found in the respective Papers 1,2,3, and 4 and Study 3.

7.2 THE ARGUMENT FOR THE USE OF A MIXED METHODS APPROACH FOR DATA COLLECTION.

This research incorporated the use of a mixed methods data collection where three studies were conducted using quantitative methodology and one used a qualitative approach (Tashakkori and Cresswell, 2007:3). In fact, a parallel mixed methods approach as defined by Chiang-Hanisko et al. (2016) was adopted. It has been found useful to employ such a strategy in healthcare research as such topics are often complex and involve many phenomena (Foss and Ellefsen, 2002; Morgan 1998). Furthermore, if in the mixed method approach the quantative and qualitative data collection and analysis is rigorous and the matters under investigation are linked or integrated the use of qualitative research can enhance the outcome of the research both in depth and understanding of the topic (Johnson, Onwuegbuzie and Turner, 2007). The latter sentiment was borne out by fact that the FGs captured the essence and depth of the anatomical experience of the qualified service delivery sector PT participants. Aspects of the research such as the psychological effects of dissection on the student psyche and the weight of the anatomy information overload would not have been garnered through the quantitative approach. The FGs presented a reflective personal insight into the world of the gross anatomy PT student from the perspective of qualified physiotherapists who recalled their experiences with the benefit of hindsight and the awareness of clinical demands.

7.3 FACTORS RAISED IN A COMPARISON OF THE GLOBAL VERSUS NATIONAL GROSS ANATOMY PT STUDENT EDUCATION PICTURE

The scoping review format for Study 1(Paper 2) documented various interventions applied and reported resultant outcomes of this type of PT education globally between 1980 and March 2018. The national gross anatomy survey carried out in Study 2 gleaned useful information pertaining to the state of gross anatomy education for PT students in South Africa. The initial tabulated flow diagram for the overall design of the thesis (Figure 1.1) illustrated the way in which the data were to be collected in order to facilitate comparisons between the global and national scenarios. Input from qualified physiotherapists in the FG discussions gave further insight into the national perspective on pedagogy used to teach gross anatomy. The documented learning style preferences of PT students (Paper 4) presented a different perspective on how to relate pedagogy and curricular design to student learning needs.

7.3.1 Identified Pedagogy

Various pedagogy identified in both the thesis and literature review as listed in Figure 7.1 with some advantages and disadvantages outlined for each type of teaching method aere highlighted below.

Dissection

Dissection was identified as an essential component of a gross anatomy programme (literature review of this thesis) as it allowed students to see anatomical variations in the human body and perceive the body as a human being (Granger, 2004; Pawlina and Lachman, 2004). In this regard, a FG discussion participant (Study 3) said: '*And also on the wall there was your cadaver number and what they died of and I …I can still see the cadaver's face very clearly. Never mind the anatomy and any of that I can…you know I remember when I looked…I wasn't upset by it … but I know what his face looked like…' ... (FG5, Quote 112).*

Four of the six respondents (67%) in Paper 3 reported that their gross anatomy programmes offered dissection to the students. As reported in the literature review and Paper 3, in the United Kingdom and Ireland dissection was still being used in 76% of anatomy programs for medical students (Heylings, 2002). In Germany, Ethiopia and in the UK it was reported that undergraduate medical students viewed dissection to be a relevant part of their course (Bekele et al., 2011; Kerby et al., 2011). Similarly, dissection was found to be the preferred gross anatomy teaching methodology by Patel and Moxham (2006) and Torres et al. (2014). Reimer,

Laurenzano and Tages's survey in 2013 (Paper 2) of PT gross anatomy programmes recorded that 92.6% of the respondents to their survey used dissection in their faculty.

It is important that gross anatomy teaching methods help with the retention of the core content into clinical practice. Hasan, Ageely and Hasan (2010) argued that the move away from traditional cadaveric dissection was not wise and that human dissection was the best way of establishing the core knowledge necessary for good anatomical knowledge retention. Similarly, Khan et al. (2015)(Paper 2) after surveying Pakistani physiotherapists and PT students found that dissection was regarded as beneficial to the understanding and retention of anatomy. Furthermore, Rennie, Naidu and Van Wyk (2011), of the University of Kwa-Zulu Natal in South Africa, found that second year medical students reported understanding anatomy in more depth when using dissection alone. The mental three-dimensional (3D) imaging associated with dissection was also linked to beneficial retention outcomes (Granger, 2004; Marks, 2000). Findings of the national survey, as presented in Paper 3, show that at the majority of the South African universities surveyed human dissection has been anatomy pedagogy from the inception of the PT programmess to date. Based on the literary findings this may augur well for the continuing retention of anatomical knowledge in students taught in this way in South Africa.

The acknowledgement of the importance of "the feel of human flesh" has been put forward as support for the use of cadaveric dissection (Böckers et al., 2010; Hasan, Ageely and Hasan, 2010; Sugand, Abrahams and Kurana, 2010; Azer and Eizenberg, 2007). Kramer and Soley (2002) support the 3D aspect of anatomical education as being necessary and dissection was put forward as a method to understand this perspective. Dissection is also regarded as a successful pedagogy in Africa (Kramer, Pather and Ihunwo, 2008). Physiotherapy is a 'hands on' profession. The palpation of tissues, the depth of structures with related 3D appreciation of anatomical relationships and the accurate location of such structures are pivotal to beneficial treatment of patients. A participant in the focus group discussions described this fact accurately saying: *' I think that you need to apply it and that your physical touching, feeling. We're manual labourers really. Use our hands. We have to feel. We have to, I mean how much of our assessments and everything are done looking and feeling?' (FG1, Quote 265).*

There was no shortage of cadavers for dissection at four of the faculties surveyed and this was reflected in the student to cadaver ratios. Gangata et al. (2010) reported

that 80% of cadavers used for dissection in South Africa were donated. They also stated that in many African countries the lack of awareness of the possibility of donating one's body together with religious and cultural burial traditions resulted in a low number of cadavers being bequeathed. Religious or cultural concerns may perhaps explain the shortage of cadaveric material in some South African provinces and be linked to the fact that two of the surveyed programs reported a high ratio of 10–12 students per cadaver.

The scoping review (Paper 2) showed that in a survey of Canadian and American gross anatomy programmes for entry level PT students prosection was favoured by Canadian programmes and dissection favoured by American programmes (Armstrong and Rosser, 1996). Furthermore, in a Varied-Integrative-Progressive (VIP) intervention prosected cadavers were used to teach gross anatomy to first year DPT students and second year DPT students dissected. Both years of student study recorded positive outcomes from the pedagogy used (McKenzie and Gutierrez, 2007).

Ethical considerations pertaining to dissection were laid out clearly in the FG discussions. In Paper 2 of this thesis, although Cho and Hwang (2017) reported that only half of the medical students they surveyed post their dissection experience expressed an appreciation for human dignity and a few reflected on life and death, these results were considerably higher than those seen pre-intervention. The relationship of PT professional behavior to dissection, as measured by Youdas et al. (2013), will be discussed later in relationship to an inclusion in Figure 7.8 of this thesis.

The distinctly unpleasant smell associated with dissection was described by Mitchell, McCrorie and Sedgwick (2004). In the discussion section of Study 3 many cited authors reported on the awful smell and its effects on the students (Getachew 2014; Leboulanger, 2011; Robbins et al., 2008-2009; Snelling, Sahai and Ellis, 2003; O'Carroll et al., 2002). Participants in the second FG remarked: ***'****I think the worst was the smell. …* ***,*** ***'****The smell of formalin'…* ***'****The smell of formaldehyde…. stuck onto you* ***…****then nobody wants to greet you because you don't smell good.' (FG2, Quotes 91,92,93 and 94).*

The literature review of this thesis has mentioned the progressive time constraints in anatomical teaching hours (Drake et al., 2009; Drake, McBride and Pawlina, 2014). Dissection is time-consuming. Gabard, Lowe and Chang (2012) stated that the

average percentage time spent in total body dissection was 60%-73% over all four categories at the time they conducted their research but the projected 2020 results predicted a decrease in the use of dissection. This prediction seems to align with trends towards an increase in the use of prosection and other gross anatomical pedagogy to teach the subject to medical and allied medical students.

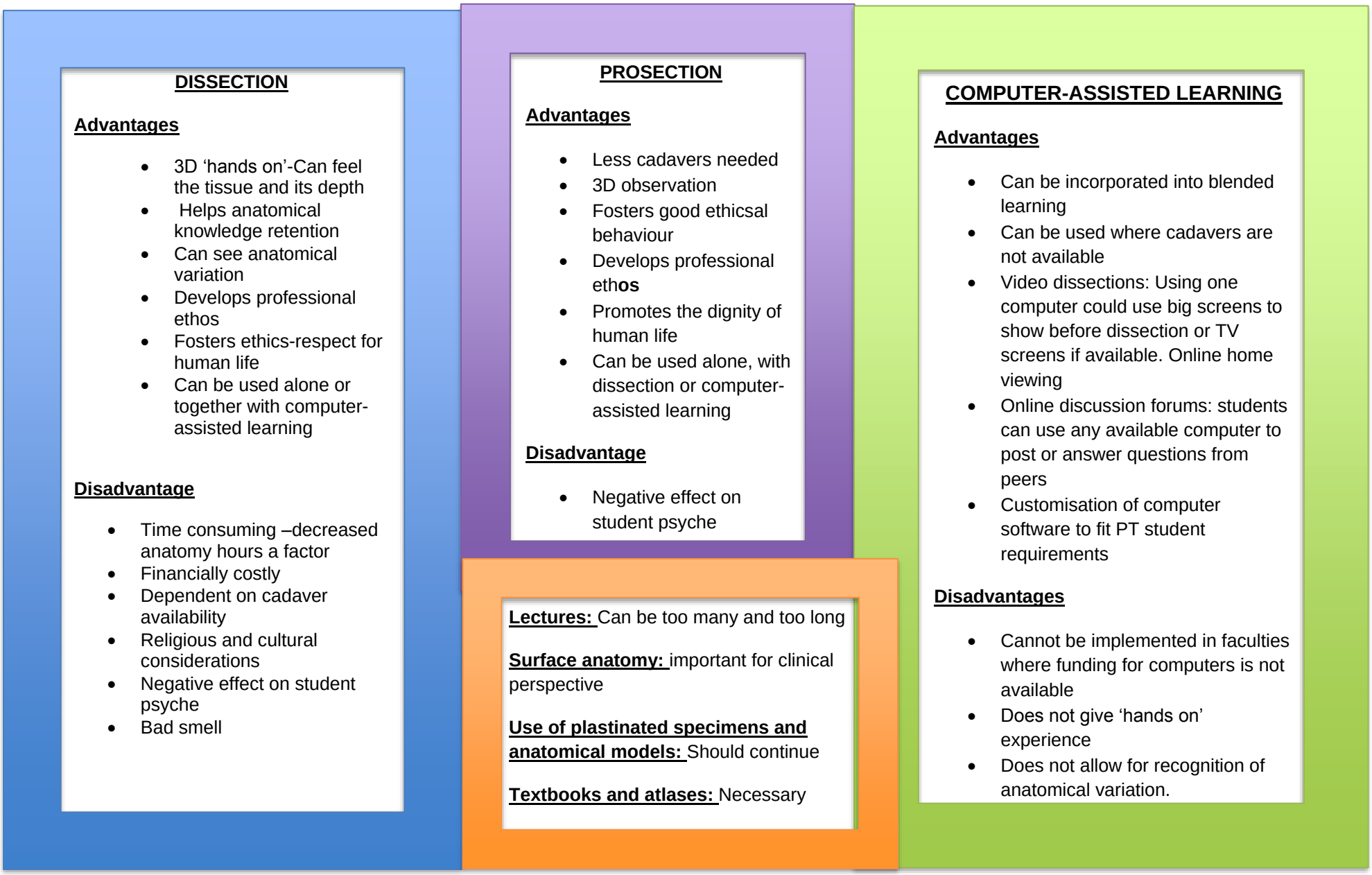

Figure 7.1: Schematic of Pedagogy for Consideration for Inclusion in the Unified Curriculum

Prosection

The scoping review (Paper 2) showed that the study interventions identified in Study 1 on global gross anatomy education for undergraduate (entry-level) PT students report on teaching methodology such as using prosection, computer technology, plastinated specimens/ anatomical models, blended learning and multi-modal learning in the main.

However, in line with similar trends in Australia and New Zealand (Craig et al., 2010), Sheikh et al. (2016) in Ireland supported prosection as beneficial for gross anatomy education albeit for medical students. Prosection, as used in studies for PT students as reported in the scoping review in Paper 2, is mainly described in its use together with other pedagogy such as dissection and computer-assisted learning (Thomas, Denham and Dinolfo, 2011; Plack, 2000; Berube, Murray and Schultze, 1999). It is also used in inter-professional learning studies and this will be covered in the section dealing with such matters (Figure 7.2).

Ethical considerations and 'dignity for human life' aspects of the observation of prosected cadavers, as they pertain to PT students, were addressed in a study by Kawashiro et al. (2009)(Paper 2). Canby and Bush (2010) used reflective strategy to ascertain DPT students' opinions of the observation of prosected cadavers by using a humanistic approach in the same paper. A participant in the second FG (Study 3) described the quandary often experienced by students regarding ethical boundaries when adequate ethical information was not supplied regarding the taking of photographs of a cadaver.

Computer-assisted learning

As suggested in the literature review computer technology cannot replace the tactile nature of dissection, the complex nature of the human body and the 'feel' of human tissue (Böckers et al., 2010; Hasan, Ageely and Hasan, 2010; Sugand, Abrahams and Kurana, 2010; Azer and Eizenberg, 2007; Pawlina and Lachman, 2004) However, as Tam et al. (2010) has noted time constraints, technological advances, increased costs related to the use of cadavers and larger classes has seen computer assisted learning being considered more frequently for use in teaching anatomy. The young age of the majority of PT students studying gross anatomy today means that they are very computer literate and therefore this teaching medium is familiar to them and they are quick to learn using it. Torres et al. (2014), after reviewing 72 articles, concluded that simulation was the second most popular method of teaching gross anatomy.

As mentioned above the literature review (Chapter 2) discussed this matter at length and the scoping review (Paper 2) reported widely on the use of computer technological for teaching gross anatomy to PT students with beneficial outcomes for anatomy knowledge retention being noted (Thomas, Denham and Dinolfo, 2011; Bukowski, 2002; Anderson and Conley, 2000; Plack, 2000). However, on the contrary, Turney (2007) reported that the move from cadaver-based anatomy to the use of computers in anatomy might not be beneficial to the understanding and retention of basic anatomical knowledge by medical students. In a very recent development where mobile devices (tablets) were used to introduce a novel anatomy software application to medical students in KwaZulu-Natal in South Africa a positive and beneficial outcome was found in respect to student access to the anatomy programme material (Lazarus, Sookrajh and Satyapal, 2017).

The customisation of computer software for PT student groups was also documented in the scoping review (Paper 2) where Janssen et al. (2014) concluded that computer-assisted learning, customized for specific group users such as allied health students, was preferable to generalised gross anatomy computer-assisted learning content. The results of the national survey reported in Paper 3 did not uncover any specific customisation of a computer- assisted learning programme for PT students in South Africa.

Green et al. (2017, 2014), Green and Whitburn (2016) and Green and Hughes (2013) in Australia have contributed to the body of evidence (literature review and Paper 2) on the use of asynchronous online discussion forums. This concept enables the posting of online anatomical questions for peers to answer and in turn answering of questions already posted by fellow peers. These authors suggest this type of learning method as an adjunct to the blended learning approach they have pioneered in Australia.

Two studies in the field of neuroanatomy for PT students (Paper 2) found this type of pedagogy very useful due to the students' ability to visualise structures increased student self-efficacy and reinforced clinical concepts (Mc Keough and Bagatelle, 2009; Foreman et al., 2005).

Two of the identified disadvantages related to computer-assisted learning were the inability to see the body in its real clinical context with anatomical variations and the budgetry constraints that restricted or prevented the use of computers in certain faculties in South Africa. The former situation was described by a FG participant

(Study 3) who referred to the fact that learning anatomy using a computer did not allow the student to see anatomical variation as the animated representation of the human body was standardised and fixed and so did not relate accurately to the real clinical picture. To the budgetry concerns gross anatomy coordinators responding to the national gross anatomy survey, Study 2 (Paper 3) said: 'there are not enough computers available in the faculty for all the students to use at once' and another, 'the university unfortunately have not approved the budget to buy computer based programme for students to use.'

Lectures

The literature review established that lectures as a form of anatomy instruction for medical students had been implemented as early as the 1900s in the USA (Louw, Eizenberg and Carmichael, 2009). Petersen and Tucker (2005) described a decrease in time spent in lectures, while Pawlina and Lachman (2004) categorised lectures as ineffective and old-fashioned. In recent times Green and Whitburn (2016) and Green et al. (2017) have created a blended learning approach where time spent in lectures is gradually reduced and replaced by online video learning.

The national gross anatomy survey (Paper 3) identified that, in South Africa the use of lectures was still high in comparison to that used elsewhere globally. The FG discussion participants also elluded to the fact that lectures can be long and boring perhaps suggesting that consideration should be given to reducing the time spent in lectures in this country (Shead et al., 2018).

Plastinated specimens/ anatomical models

The literature review identified that plastination techniques were developed in 1977 and since then many anatomical specimens have been prepared in this way for students to examine (Von Hagens, Tiedemann and Kriz, 1987). Medical students have used such specimens and found the use of such models very useful (Moxham et al., 2016; Riederer et al., 2015; Azu et al, 2012). The use of such specimens either alone or in combination with anatomical models was noted in the results of the national survey (Paper 3). Respondents noted that such specimens or models were used; 'due to a shortage of cadaveric material' or because 'large models were helpful to show small structures like the eye' 'or could be used to show structures not easily seen on a cadaver.'

A participant in the FG diuscussions (Study 3), when referring to the use of such specimens for revision purposes, said: ***'We had a similar thing…we call it… IT'S***

HORRIBLE…(Laughter from the group). We called it the 'biltong book' but it was open like twenty- four hours. You'd swipe in with your student's card but then the lecturer who taught anatomy would go before…like a week before the test…say this week we're doing upper limb …she'd like rotate and move things around so like it's all the upper limb things so it's easy for you to go there in your free time and revise upper limb because all the upper limb were like sort of displayed and marked so that helped a lot. That really, really helped' (FG4, Quote 36).

Textbooks

In the scoping review a study by Bukowski (1980) compared textbook learning with self-instruction in gross anatomy. At that time, textbook learning was found to be preferable. The FGs (Study 3) also discussed the use of textbooks and atlases and there was an inclination to still use atlases for reference during clinical years.

TYPES OF LEARNING PROGRAMMES

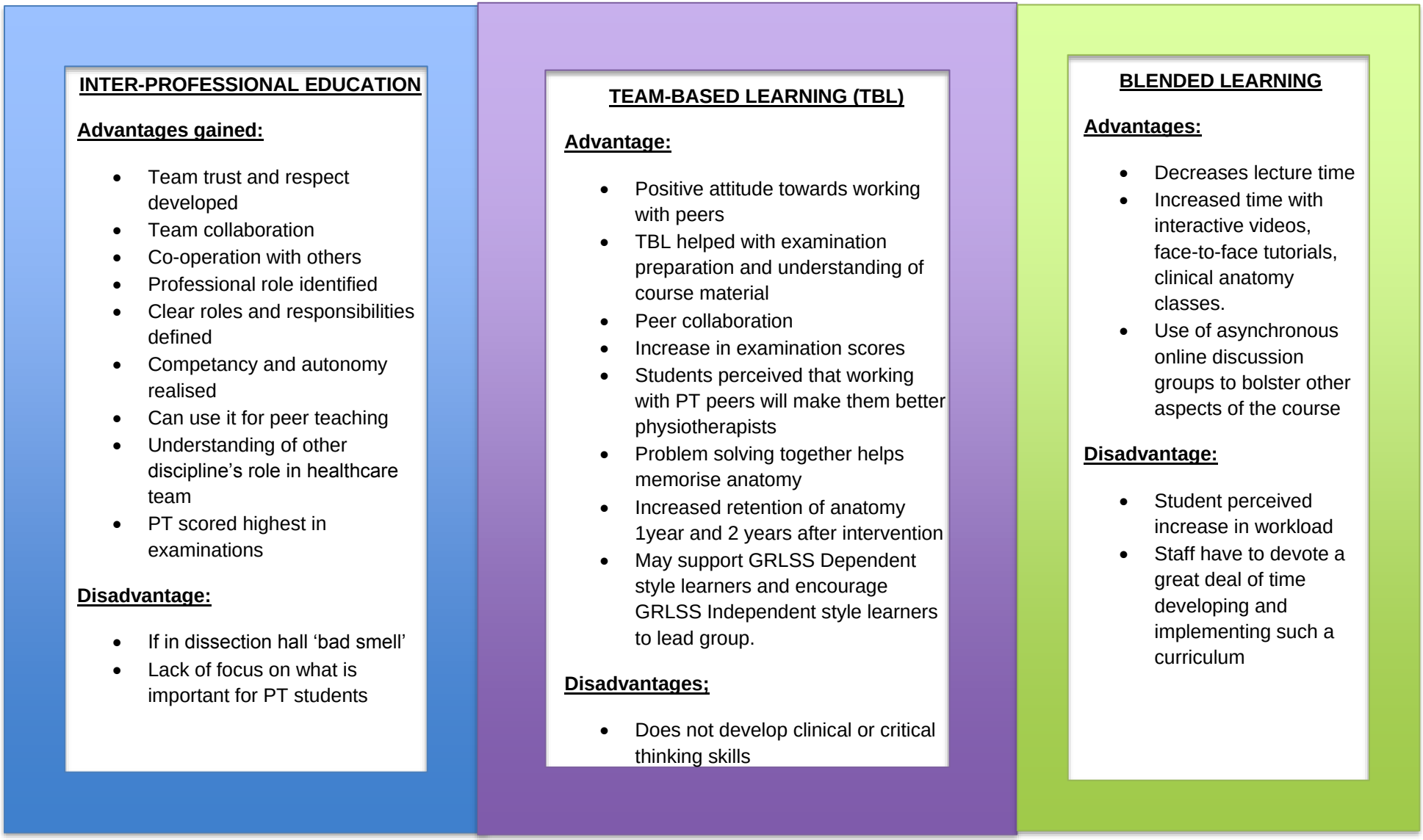

Figure 7.2: Schematic of Types of Learning Programmes Considered for Inclusion in the Unified Curriculum

7.3.2 Types of Learning Programmes

Matters pertaining to different types of learning programmes are outlined in Figures 7.2 and 7.3.

Blended learning

The blended learning approach to anatomical teaching has been explained in the literature review, the scoping review (Paper 2) and under computers in the discussion section of this thesis so will not be further discussed here.

Inter-professional education

The concept of inter-professional education as stated in the literature review prepares allied health students for the clinical role they will play as part of a clinical healthcare team (Cox et al., 2016; Thistlewaite, 2012; Abu-Rish et al., 2012; CAIPE, 1997). However, it has been a popular learning programme for the teaching of gross anatomy to PT students in particular (Luetmer et al., 2018; Meyer et al., 2017; Fernandes et al, 2015; Shields et al., 2015; Sytsma et al., 2015; Hamilton et al., 2008; Mitchell et al., 2004). Interest in this type of learning programme for PT students peaked in 2015. In particular, PT students showed an improvement in examination scores (Mitchell et al, 2004). Overall, these programmes were well received by PT students and it was noted that students gained much more understanding of the roles played by other disciplines in the healthcare team and the experience boded well for future interdisciplinary team cooperation in the clinical setting.

From the FG discussions (Study 3) it was seen that, while most interprofessional interactions were with the OT students, other groups, including medical students, also shared practical sessions with PT students. Much of this picture was mirrored in the findings of the national survey where the PT students mainly interacted with the OT students but also engaged with students from many other disciplines in different regions in the country (Shead et al.,2018).

This type of learning programme was used in combination with team- based learning and peer teaching/tutoring/ mentoring scenarios as described in the following sections.

Team-based learning

Team-based learning is focussed and planned and includes student readiness assessment sessions and peer review (Nieder et al., 2005). These researchers found that team-based learning encouraged continuous study. An Iranian study found that

team-based learning either alone or together with traditional lectures enhanced learning in their medical students (Ghorbani, Karbalay-Doust and Noorafshan, 2014). Team-based learning motivates and promotes development of responsibility within the team dynamic (Vasan, DeFouw and Compton, 2011). In the same study, the students' performance improved as students engaged in active learning and peer teaching. The national survey (Paper 3) did not delve into the details of team-based interactions in the various South African Health Science faculties but it did note that 50% of the respondents reported that their gross anatomy programme offered team-based learning.

Although not stated specifically in Paper 4 the inference that may be drawn from the 2015 GRLSS cohorts' result is that the overall Dependent learning style could predispose such students to being assisted in the team-based learning scenario. The scoping review of this thesis (Paper 2) documented a study by Livingston, Lundy and Harrington (2014) indicating that the GRLSS Collaborative learning style could possibly be apportioned to team-based anatomy learning where PT students exhibited a positive response to anatomy. Both the 2015 and 2016 student GRLSS cohorts ranked the Collaborative learning style second and third overall respectively perhaps suggesting a positive disposition to the learning of anatomy within the student groups. Furthermore, a comprehensive team-based learning intervention with peer teaching and dissection (Paper 2), involving DPT students, showed positive academic outcomes and retention of anatomical information (Huitt, Killins and Brooks, 2015).

Peer teaching/ tutoring/ mentoring

The literature review (Chapter 2) and scoping review (Paper 2) uncovered studies pertinent to this topic. Peer teaching can be used to strengthen communication skills (Krych et al., 2005). Various ways of delivering such peer interactions were described in the literature. Recipricol peer teaching was found to be an effective way to impart knowledge to medical students (Manyama et al., 2016; Wilson et al., 2011; Sandra and Ferguson, 2009) and to PT students (Youdas et al., 2007).

The most common methodology for applying this type of teaching programme for PT students (Paper 2) is in conjunction with team-based learning (de Oliviera et al., 2015; Huitt, Killins and Brooks, 2015; Livingston, Lundy and Harrington, 2014; Youdas et al., 2008; Lake, 1999). Wait et al. (2009) utilised peer teaching in combination with an ARS system. In general, these studies reported a beneficial effect regarding the learning and retention of gross anatomy for both the peer

teacher/tutor/mentor and the peer recipient in each case. Peer tutors also developed better communication skills.

The national survey (Paper 3) did not ask respondents to elaborate on peer teaching experiences but it was seen that 67% of responding faculties supported the use of this type of learning programme (Shead et al., 2018).

It can be extrapolated from the results of Paper 4 that peer teaching/tutoring/ mentoring may be helpful to students with the GRLSS Dependent learning style as it will give them the added support and attention they require.

TYPES OF LEARNING PROGRAMMES (continued)

PEER TEACHING/MENTORING/TUTORING

Advantages:

- Peer mentoring can be used to teach large diverse student groups
- Mentees scored higher in examinations
- Peer mentors and peer teachers gained better knowledge and understanding of anatomy
- Use of Audience response system (ARS) with 'clickers' gave immediate feedback – built students' confidence, helped students gauge how well they understood a topic and was a catalyst for further anatomical discussion
- Peer teachers could see how well students had understood presentation nd adjust teaching accordingly
- Bond developed between peer teachers and students
- In peer teaching a student said; 'I liked the ability to ask questions and have them explained in a new way'
- Worksheets supplied by peer teachers were liked
- Peer teachers said experience helped them revise, understand and apply anatomy better and had improved teaching confidence
- Number of times that students attended peer tutoring sessions was directely proportionate to examination success

Disadvantages:

- The survey did not identify why some students had not participated
- Need to identify why some students improved marks after only one peer mentoring session
- ARS method did not afford enough interaction, and was too passive.
- Peer teachers found the experience of preparing and delivering anatomy to students time-consuming and a heavy workload.
- At times peer teachers could not answer students' questions
- Dissection time was impacted unfavourably

Figure 7.3: Schematic of Types of Learning Programmes Considered for Inclusion in the Unified Curriculum (continued)

7.3.3 Novel Teaching Interventions

Figure 7.4 illustrates an overview of novel teaching interventions.

As the name suggests multi-modal delivery of anatomy knowledge incorporates a number of pedagogies used in conjunction with each other in order to address many different aspects of the student's way of learning. However, as was suggested in Paper 2 (Chapter 3) relating to these matters there is an overlap between the interventions seen in many of the studies and therefore they were categorised according to the intervention that was specific to the outcomes generated.

The literature review (Chapter 2) pinpointed that a new attitude among medical students required a different and multi-faceted approach to the teaching of anatomy programmes (Reidenberg and Laitman, 2002). In this respect, the 'MCOE' undertaken by Gangata (2008) with PT was innovative and added a new dimension to the spatial orientation aspect of muscles.

The scoping review (Paper 2) collected two studies that were specifically designated as multi-modal (Langfield, Colthorpe and Ainscough, 2017; Nicholson, Reed and Chan, 2016). The latter of these two studies utilised four different learning experiences. These learning modalities would possibly relate to the VARK learning style model explained in the literature review (Chapter 2). Meyer et al. (2017) included PT, orthopaedic and clinical stations in their multi-modal intervention. Online videos were either used alone or in combination with other teaching methods (Langfield et al, 2017; Green et al., 2017, Green and Whitburn, 2016; Ogard, 2014). Anderson and Conley (2000) added a computer assisted learning programme to other teaching methods that included the use of radiographs, MRI, surface anatomy, anatomical models and lectures in an anatomy programme for PT students. Although no individual statistical data was given for the PT student group, overall the majority of students found that the workshop improved their academic performance and helped them prepare for examinations.

All studies using multi-modal aspects of learning reported that students had enjoyed the experience. On the negative side, such workshops or interventions required a lot of time for preparation and set up.

7.3.4 Course Content

Figure 7.5 illustrates the course content suggested for undergraduate PT students found in the literature review (Chapter 2), the gross anatomy national survey (Paper

3) and formulated from the opinions of the qualified physiotherapists who took part in the FG discussions. Generally the inclusions suggested in the global literature (Paper 2) are also contained in the opinions of the professional physiotherapists (Study 3). However, there is some discrepancy between these two results as to the rating of the different anatomical regions and systems. The available plastinated specimens in health science faculties as recorded by the national survey (Paper 3) shows that the types of regional and systemic specimens and models available for PT students to learn with did not match with those most needed by PT students.

7.3.5 Class Features and Teaching Approach

Figure 7.6 illustrates the features of the classes and the teaching approaches adopted.

Class features

According to the scoping review (Study 2) in the 2013 USA survey by Reimer, Laurenzano and Tages (2013) the majority of PT classes ranged between 31 to 50 students. Three years later Shead et al. (2018)(Study 2) noted an average increase in class sizes in South Africa. This chronological increase in class sizes was also very apparent by comments made in the FG discussion groups and this was linked to the increase in group size such as for dissection groups as indicated by the incremental change in dissection group sizes between the 2013 USA survey and that conducted in 2016 in South Africa.

In this regard, a FG participant remarked that: ***‘*** *If we’re on the actual class size. I mean when I did physio I was one of 29. Now the physio class is like 60-70. So I mean the classes…the groups are going to be a lot bigger ‘(FG3, Quote 315).*

NOVEL TEACHING INTERVENTIONS AND MATERIALS

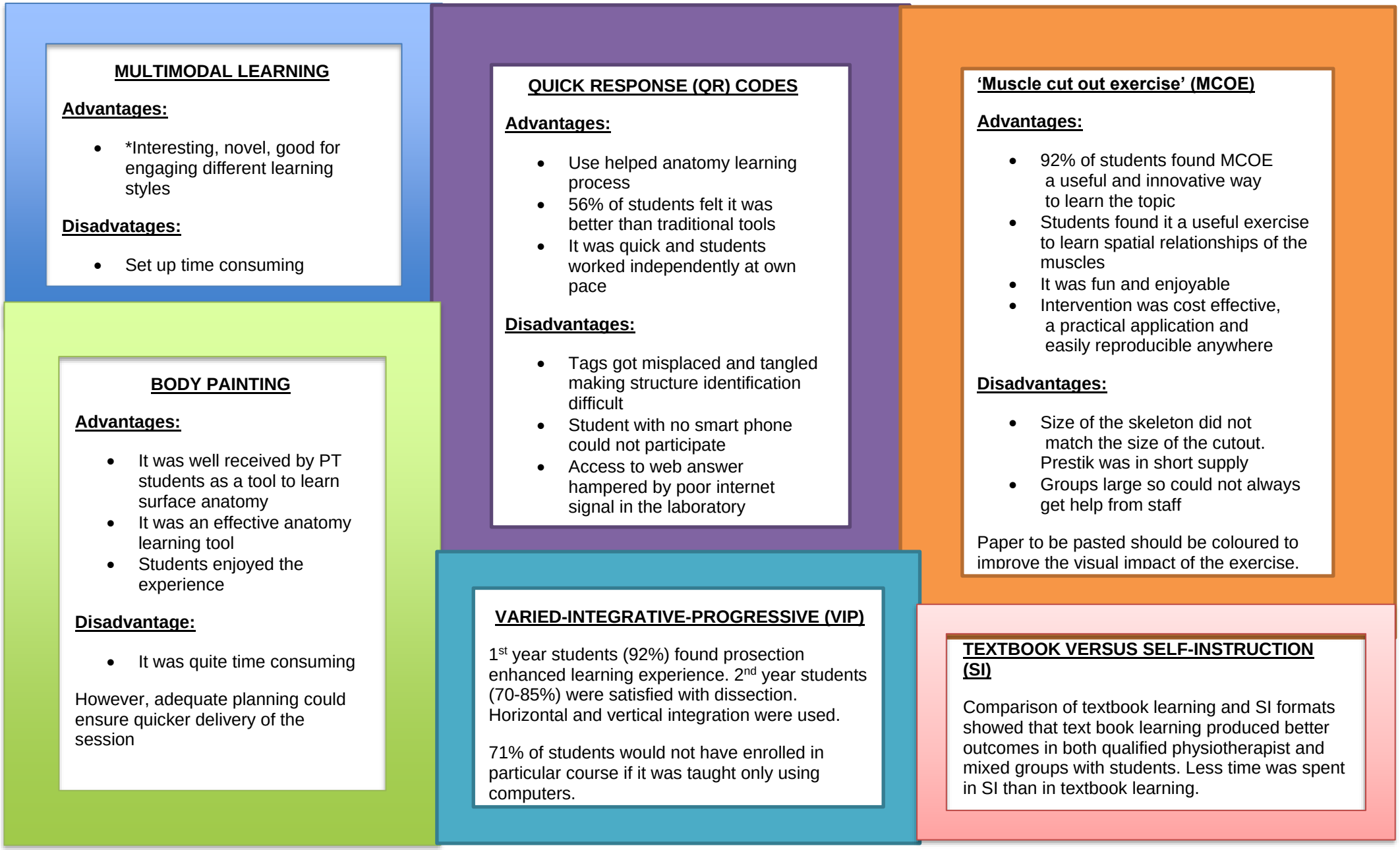

Figure 7.4: Schematic of Novel Teaching Innovations and Materials Considered for Inclusion in the Unified Curriculum

COURSE CONTENT

Rating of preferred inclusions in descending order (global literature):

1. **Upper limb** – brachial plexus in particular, primary blood vessels and metacarpophalangeal (MP) and interphalangeal (IP) joints 2. **Back region**- vertebral column and spinal cord 3. **Lower limb-** primary blood vessels and metatarsophalangeal (MT) and IP joints 4.**Thorax**- thoracic wall, heart, lungs and coronary arteries 5. **Head and neck** – brain and prevertebral and lateral vertebral regions 6. **Pelvis** – lumbosacral plexus, pelvic floor and pelvic wall. 7. **Abdomen**- Abdominal viscera, blood vessels and nerves of abdominal viscera.

In general course content in the USA mirrored that in Canada.In USA more emphasis on back and in Canada on abdomen. Both emphasised upper and lower limbs.

Numbers of plastinated specimens by region or system from national gross anatomy survey in descending order: 1.Thorax, muscular, eye and face (83%) 2.Nerves, pelvis, abdomen, neck, sinuses, oral cavity, ear and circulatory (67%) 3.Gluteal, lower limb, upper limb, neurological and skeletal (50%) 4. Other included the perineum.

Preferred inclusions according to code frequency in descending order (Focus groups):

Spinal cord, muscle, brain, osteology, upper limb, lower limb, fascia, brachial plexus, nerves and lungs.

In both the global literature and the FG discussions the gastro-intestinal tract (GIT) was the least preferred region and the physiotherpaists in the FGs recommended that the finer details of the GIT should not be included in a gross anatomy curriculum for PT students.

A 1994 study suggested that the rating of different areas of the body more favourably may have coincided with the advent of PT specialisation.

Figure 7.5: Schematic of Course Content Considered for Inclusion in the Unified Course Curriculum

Teaching approach

The literature review (Chapter 2) identified as the main challenge in this regard whether a systemic approach or a regional approach should be adopted (Moxham and Pais, 2016). It is argued by these authors that the systemic approach fits well with problem-based learning as found in the integrated medical curriculum (Pais and Moxham, 2013). The regional approach looks at structures in the major regions of the body such as the head and neck, thorax and perineum (Pais and Moxham, 2013). It is better suited to a programme incorporating dissection into its framework.

The scoping review (Paper 2) that looked specifically at gross anatomy education for undergraduate PT students presented a more focussed view on approaches used to teach this specific student body. From the information gathered in a survey by Armstrong and Rosser (1996) comparing approaches to anatomy teaching in the USA and Canada it was obvious that the regional approach was adopted by the vast majority of American programmes but the Canadian programmes, while still favouring the regional approach, also subscribed to a mixed methods approach. In 2001 Latman and Lanier reported a slight preference for the regional approach in the USA but the percentage of PTs reporting this as the teaching approach used for them had decreased dramatically than that reported in the 1996 USA survey. Although Reimer, Laurenzano and Tages (2013) did not specifically address the matter of the type of approach to teaching they reported that a high percentage of the targeted personel in PT schools in America used dissection to teach gross anatomy and that it is often associated with the regional approach.

The 2016 South African survey (Paper 3) showed an even distribution between a regional approach on the one hand and a systemic and mixed combination of approaches on the other hand (Shead et al., 2018).

In a FG a participant said: ***…****'I don't know …I just prefer learning it all together because then you learn where the muscle attaches on the bone and that's how you learn the bone otherwise your learning all the things of the bone but it doesn't…it's not really relevant to you like learning the greater trochanter…cool…I know where it is but I don't know what attaches and even if I learn what attaches I don't know what that muscle is. That's why for me I think it's better to learn it in sections like together with the muscles and nerves and everything. 'Cos then you know what nerve, where it runs through like and a lot of it makes sense ' (FG2, Quote 150).*

7.3.6 **Clinical Input**

Figure 7.7 illustrates facts pertaining to clinical input into a gross anatomy curriculum for undergraduate PT students.

The hierarchy pyramid of anatomical concepts that link gross anatomy curriculum to clinical application was devised by the AACA (1996). In order to achieve the clinical anatomy goal at the top of the hierarchy pyramid horizontal and/or vertical integration of clinically relevant information is essential. Clinicians well versed in anatomy can teach this subject to relevant student bodies. The incorporation of clinical personnel to teach anatomy leads to inter-professional integration (Wisco et al., 2015). Latman and Larnier (2001) (Paper 2) further clarified this statement by concluding that a gross anatomy course should incorporate clinical knowledge pertinent to the discipline of the students being taught. In 2013 Reimer, Laurenzano and Tages found a decrease in the number of PT qualified persons teaching anatomy to PT students in the USA when they compared their results to those found by Mattingly and Barnes in a 1994 survey.

Figure 7.7 clearly describes two vertical integration studies (Paper 2). The first, involving various joints of the upper and lower limb and the second allowed students to re-visit respiratory anatomy (Krause, Youdas and Hollman, 2011; Parmar and Rathanam, 2011). A horizontal integration study saw PT students performing the Lachman test on lightly embalmed cadavers (Janssen et al., 2014). Students liked these interventions and wanted more of this type of teaching to be incorporated into the appropriate part of the anatomy programme.

The early clinical exposure intervention undertaken by Prithishkumar and Holla (2012) enabled students to apply neuroanatomy knowledge to the clinical scenario. The PT students found that such a learning experience helped them retain the anatomy information and wanted more similar experiences to be carried out.

CLASS FEATURES AND TEACHING APPROACH FOR A GROSS ANATOMY CURRICULUM FOR PT STUDENTS

TEACHING APPROACH

Global literature: In 1996 USA 97% and 64% Canadian faculties preferred regional approach. In 46% of the Canadian faculties the mixed approach incorporating both systematic and regional approaches was recorded. Only one of the American faculties had a mixed approach. In a 2001 study PT professionals (54%) had mainly studied anatomy using a regional approach. A mixed approach course was least reported but 35% of PT professionals recommended it.

National South African survey: In 50% of the programmes the approach was regional. The systematic approach was found in one faculty (16.7%) and two faculties (33.3%) used a mixed teaching approach.

Focus group discussions: From the discussions it was clear that the majority of the participants were taught using the regional approach or a combined approach. One participant in FG4 mentioned that in her year they had been taught using a systematic approach but she expressed that she would have preferred a regional approach.

CLASS FEATURES

In the **2013 global literature USA survey**: the most recorded number of PT students per class was between 31-50 (57.35%). The ratio of students to cadavers was 4-6 (87.5%). Average number of cadavers available 8.72.

In the **2016 SA national survey**: average PT students per class 60.5 (±12.6). Dissection/prosection groups mean 8.0 (±3.5) per cadaver. Mean number of cadavers available 6.4 (±SD 7.3).

In the **2017 FGs** it was clear that chronologically class sizes had increased over the last twenty years. Dissection/prosection group size ranged from 2-10 with an average group size of 6. Although these conclusions are made while comparing data from different continents the trend for more students to be in the class with less available cadavers has to result in an increase in students per cadaver and this is recorded in the 2016 South African national survey in particular.

Figure 7.6: Schematic of Class Features and Teaching Approach Considered for Inclusion in the Unified Course Curriculum

The early introduction to clinical experience with resultant enthusiasm for and understanding of anatomy by a student is illustrated below in a quotation from a FG.

The FG participant remarked: *'…we start going to clinicals from second year …second semester so we start quite early …er...sort of going to clinical …I can see patients and see injuries although we're just doing …sort of just subjective assessments but also you're hearing things that he brings up …stick. Only then did I start to appreciate it' (FG3, Quote 45).*

7.3.7 **Staff Characteristics**

Figure 7.8 illustrates matters arising with respect to the staff teaching gross anatomy.

The literature review identified the fact that there is a decrease in suitably qualified staff to teach gross anatomy. This fact was underlined in a literature review by Bergman, van der Vleuten and Scherpbier (2011) carried out between1950 and 2007 who found that student to staff ratios had increased substantially over that period and even doubled in some institutions. The term suitably qualified staff has also been used to define whether the staff teaching anatomy are suitably medically qualified in order to have insight into the reasoning behind why the subject is taught and its clinical relevance by the same authors. The lack of suitably qualified staff has been linked to financial constraints (Gabard, Lowe and Chang, 2012; Thomas, Denham and Dinolfo, 2011; Wilson et al., 2011).

Similarly, the scoping review (Paper 2, Chapter 3) also identified that a decrease in suitably qualified staff to teach gross anatomy to PT students had occurred in the USA between the survey by Mattingly and Barnes (1994) and that done by Reimer, Laurenzano and Tages (2013). There is a FG participant's quotation (Study 3, Chapter 5) in Figure 7.8 pertaing to this matter.

A comparison of staff years of experience in America (Reimer, Laurenzano and Tages, 2013) and South Africa (Shead et al., 2018) (Paper 2, Chapter 3) suggests staff are more experienced in the USA but there is three years difference in the dates of the two surveys and they took place on different continents. A quotation by one of the FG participants regarding her anatomy professor illustrates that some of the lecturers are very experienced.

CLINICAL INPUT CONSIDERED FOR INCLUSION IN A GROSS ANATOMY CURRICULUM FOR UNDERGRADUATE PT STUDENTS

- The scoping review literature identified a Horizontal integration study (Janssen et al., 2014) that looked at introducing anterior cruciate ligament (ACL) testing on lightly embalmed cadavers to combine the PT testing principle with anatomy knowledge.
- Similarly in a vertical integration study Krause, Youdas and Hollman (2011) involved second year PT students in a study where students performed various clinical tests on the knee, ankle, shoulder, elbow and hand/thumb joints on cadavers. Both of these interventions proved beneficial to student competency and confidence in performing such tests. Furthermore, the 2014 study found improved examination scores on the topic in the test group and the 2011 study noted improved interest in anatomy and improved understanding of the subject. All 2011 students felt that this form of anatomical learning should be included in the musculoskeletal part of a course.
- Another vertical integration study showed that revisiting respiratory anatomy in the final year of a PT course was useful to student learning but Parmar and Rathanam (2011) admitted that the sample size was small and the intervention of short duration so that could have impacted the results.
- An Early Clinical Exposure (ECE) intervention (Prithishkumar and Holla, 2012) was given to students nearing the end of their first year where they had an opportunity to have two patients with spinal cord lesions and two with brain injury clinically presented to them. The intervention helped with retention of neuroanatomy information and was something that the students felt would assist in the learning of more work. In the FGs one of the participant had a similar experience in second year and remarked: “We start going to clinicals from second year …second semester so we start quite early and it’s only and I get that…er...sort of going to clinical …I can see patients and see injuries although we’re just doing …sort of just subjective assessments but also you’re hearing things that he brings up …stick.” (FG3, Quote 45).

Figure 7.7: Clinical Input Considerations for Inclusion in a Gross Anatomy Curriculum for Undergraduate PT Students

STAFF CHARACTERISTICS FOR A GROSS ANATOMY CURRICULUM FOR PT STUDENTS

In the scoping review literature it was seen that the number of PT qualified anatomy staff had decreased by 20.4% between 1994 and 2013. The FG discussions indicated that the particpants felt that if a gross anatomy instructor was a qualified physiotherapist it was an advantage as such a person was able to relate the anatomy information to actual case studies and knew what was most pertinent to PT practice. A participant clarified this viewpoint by saying: “Our table doctor was a physio so she related a lot of what we were seeing and doing to patients we would see in the future so that made it quite relevant to us so I really, really enjoyed the dissection…” (FG5, Quote 33).

Staff experience: The 2016 South African survey found a mean 8.6 (± 3.3) years. The global scoping review found that in the USA in 2013 the majority (27.5%) of respondents to a survey had > 20 years experience. In the FGs one participant alluded to the fact that her anatomy professor was very experienced: “ …our lecturer had actually made ‘cos he’d been teaching anatomy for don’t know…centuries now (laughter from group members) I’d like to say that he’d been there for quite a long time.”

Two important matters that were raised in the FGs were that anatomy staff should be proficient in English and not have heavy foreign accents. Furthermore, some students could not hear what the lecturer was saying or see the video screen clearly. Continuity of staff is also an important matter as it adds stability to the way in which the subject is taught and is less confusing for students.

Figure 7.8: Schematic of Staff Characteristics for Consideration for Inclusion in a Unified Gross Anatomy Curriculum

Study 3 (Chapter 5) resulted in some clarification of points that weren't raised elsewhere.

In relation to the foreign accents that made the understanding of the lecturer difficult a FG participant said: *'Our experience was there was one in particular that…we struggled to understand his English. He was a foreigner and he was very, very heavily accented and everyone didn't understand what he was saying' (FG5, Quote 45).*

In relationship to the inability to hear the lecturer and see the video screen another participant said *'…you can't hear the lecturer properly because the sound doesn't travel out and you can't see the screen…oh! It's a nightmare!' (FG3, Quote 327).*

Lack of staff continuity was very disruptive to the learning process. A participant said: *'So ours was quite disruptive through our year our staff changed literally every semester ' (FG3, Quote 26).*

7.3.8 **Professional, Ethical and Psychological Aspects**

These aspects of the thesis arose from the scoping review (Paper 2) and Study 3. The qualitative research was particularly useful in collecting information relating to the psychological considerations especially associated with dissection.

As previously mentioned in section 7.3.1 on pedagogy Youdas et al. (2013) conducted a brief intervention in a gross anatomy programme using dissection. The intervention was brief but the authors found that the professional attitude of the PT students improved. Both Canby and Bush (2010) and Kawashiro et al. (2009) undertook interventions that made the PT students aware of the humanistic aspect of interacting with a cadaver.

A topic raised by the FG discussions was that of the effect of dissection on the student psyche. This matter has been extensively discussed in the literature but was not included in either Paper 2 or Paper 3 of this thesis as that research was carried out prior to the holding of the FG discussions. It was obvious from the comments made in the FGs (Study 3) that for some students seeing the cadavers face caused upset especially if it looked like a family member. As reported by participants the effect of dissection on the student psyche could even lead to deregistration from the degree course.

PROFESSIONAL, ETHICAL AND PSYCHOLOGICAL ASPECTS OF GROSS ANATOMY EDUCATION FOR UNDERGRADUATE PT STUDENTS

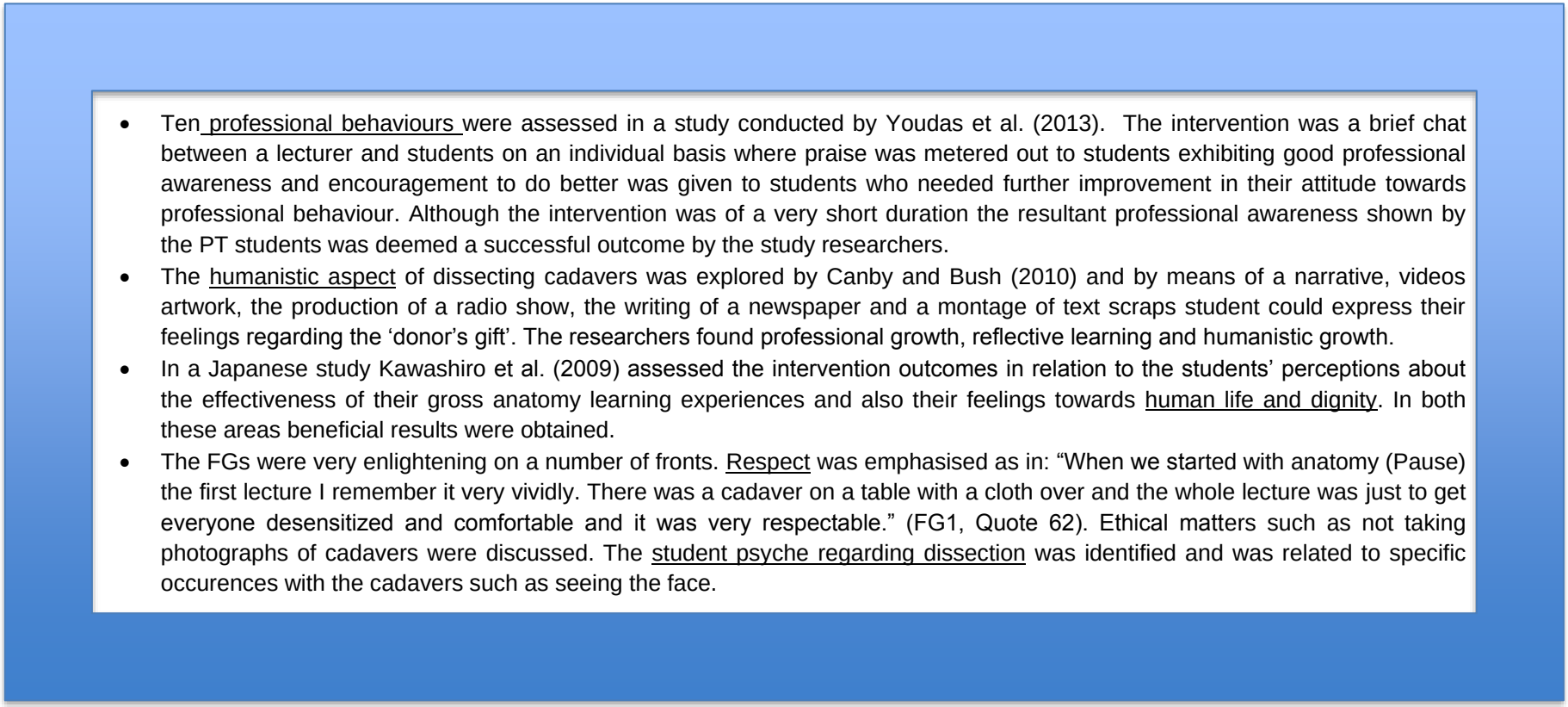

Figure 7.9: Schematic of the Professional Ethical and Psychological Aspects Considered for Inclusion in a Gross Anatomy Curriculum for Undergraduate PT Students

The stress of the dissection room experience has been written about at length in medical literature (Sándor, Birkás and Györffy, 2015; Getachew, 2014; Izunya, Oaikhena and Nwaopara, 2010; Finkelstein and Mathers, 1990). The latter two authors have compared the effect on a student's psyche as being akin to experiencing post-traumatic stress disorder.

A term that is used to describe the preparation of the student for the first interaction with a cadaver is called de-sensitisation. In this respect, various rituals are perfomed to introduce students to the task but also engender respect for the cadaver and appreciation for the 'donor's gift' (Riederer, 2016). Jones, Lachman and Pawlina (2014) described how donors were honoured in medical memorial ceremonies in the USA. Rituals and ceremonies are also carried out in South Africa.

A Study 3 (Chapter 4) FG participant remarked on these matters saying:
So with us they made it very clear and even in…we had dedication ceremony before we started and when we finished and the whole idea like was in it was they kept reiterating…You must remember this is somebody's husband or wife, chi…like daughter, son, mother, father. This is a human being and have respect for that so they were very good with us with laying that down …making sure we WERE aware of it' (FG4, Quote 197).

7.4 CONCLUSION TO THE DISCUSSION

This discussion chapter highlights the multiplicity of aspects to be taken into consideration when designing a possible curriculum to teach gross anatomy to an undergraduate PT student body. It highlights the connections between the literature review (Chapter 2) and the respective studies of this thesis with regard to such aspects of gross anatomy education. It identifies the areas where common ground or disparity lies between the findings of each of the studies undertaken in this reaserach project. In conclusion, this discussion enables conclusions to be drawn on the way forward to suggesting a unified curriculum and pedagogy for undergraduate PT students in South Africa. The conclusions arising from this thesis are presented in Chapter 8 of this thesis.

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CHAPTER 8

8. CONCLUSIONS

As this thesis collected the various data it became apparent that a suggested framework for a unified South African gross anatomy curriculum for undergraduate PT students would have to recommend changes to the overall sytem and facilities that were being used to conduct such programmes. Decreased anatomy instructional time is a global reality. Although it may similarly be the case that hours allocated to gross anatomy teaching have decreased chronologically in the South African scenario five out of the six faculties that responded to the 2016 survey had more hours available for gross anatomy than the global average. However, if time allocation for gross anatomy programmes in South Africa starts to fall to be more in line with that seen globally the use of dissection, which is a time-consuming exercise, may be adversely affected.

Only one faculty that responded to the survey had a problem obtaining cadaveric material and so the continuation of dissection and/or prosection should continue at this time in faculties with adequate cadaveric material and consideration should be given to try and source more cadaveric material for the faculty that was lacking in this resource. This could possibly be done through agreement with the other faculties. However, in the future a second aspect to the procurement and management of cadaveric material may arise. The identified chronological increase in student numbers may lead to a situation where it is not possible to match the need for cadavers for teaching purposes with the availability of the resource. Furthermore, the increased number of cadavers required to meet the teaching demands will have to be housed and appropriately managed leading to the need for larger facilities to be built. This will result in an increased financial burden on already cash-strapped health science faculties. Hence, while the continuation of dissection is a preferable pedagogy for PT students due to its 3D, ‘hands on’ and professional and ethical value extraneous factors may lead to its demise to some extent in the future. The afore-mentioned increase in student numbers raises other concerns. It may lead to more than eight students dissecting or observing a prosected cadaver at the same time and this leads to a situation that is detrimental to their learning experience. In order to have more effective use of cadaveric material consideration might have to be given to a rotational dissection programme where one cadaver is used by two groups of students of the same or similar discipline. Furthermore, faculties are going to have to employ more staff to teach the increasing number of students and costs will escalate in this regard.

The question then is raised as to what pedagogies could be used in the future to replace some or all of the time allocated to dissection /prosection. This thesis has identified that globally trends towards the blended learning approach and the use of online videos for anatomy instruction are being promulgated as the new way forward in gross antomy education. However, computer technology is also costly. It requires the allocation of space for the computers and specialised staff to maintain and set up the computer programmes. Half of the health science faculties in South Africa cannot offer students computer assited learning at the present time so the lack of such resources would also have to be addressed before a plan to implement this pedagogy could go ahead on a national unified basis. The literature, at this time, does not show that this form of teaching results in proven better results than dissection or prosection either alone or in combination with other traditional pedagogies. Furthermore, some of the global literature and the 'voice' of qualified South African physiotherapists seemed to show a preference for the continuation of dissection and/or prosection. In particular, computer technology was only deemed as useful as an adjunct pedagogy. However, students can access the computers for self-study and this is an added benefit to the use of theis pedagogy. Therefore, it is apparent that a juggling act will have to be performed on an ongoing basis to try and maintain the inherent value of dissection against the demand for time saving computer technology. This dilemma also presents the additional proviso that financial constraints may dictate choices overall in this regard anyway.

Surface anatomy was identified as being important to the learning of anatomy at an undergraduate level. The ability to be able to identify the location of internal anatomical structures using surface markings on the skin was linked to the clinical scenario where it helped the physiotherapist diagnose conditions accurately and could assist with explaining treatment to a patient. It was therefore identified as being a necessary inclusion in the PT students' anatomy pedagogy. However, religious and cultural concerns were raised as reasons for this not being implemented at times. In order to address these concerns the drawing of surface anatomy reference points on cadavers before the dissection of a specific area was seen to be an effective way to overcome religious or cultural difficulties. In many cases the use of student volunteers, mostly male students, was also identified as a way of overcoming these obstacles. Hence, surface anatomy can and should be carried out in a gross anatomy programme.

Although not widely favoured lectures still play a large part in some of the South African anatomy programmes. This research highlighted how these can be boring, long, tedious and non beneficial. This appears to be one area that can be improved by a reduction in the

time spent in lectures brought about by the implementation of the delivery of such material by means of interactive tutorials, team-based learning sessions and online videos if computer technology is accesible. Furthermore, topically relevant team-based learning sessions can be instituted with peer group teaching. The peer group teachers can use prosected material, plastinated specimens or anatomical models to illustrate their topic. Recipricol peer teaching can also be instituted within the format where students from one discipline such as PT present the shoulder joint to the medical students and in return the medical students present the heart to the PT students. This form of interprofessional interaction has been identified in the literature as being beneficial for future clinical teamwork and can give insight into how their discipline and other diciplines would approach case studies. It enables students to develop confidence in their anatomical knowledge and the preparation and presentation helps with anatomical retention. This form of learning does require some extra preparation on the part of students but if they can see that it helps with learning they will become more committed to the process.

Textbooks and atlases are a useful adjunct to other pedagogy and can be sourced and worked with on ipads or mobile phones. The quality of the textbook or atlas and its appropriateness fas a learning tool for the degree course that it is prescribed for is important. From this research it was apparent that textbooks, whether in print form or downloaded onto a technological device, still hold an important place in the student's learning material.

A number of novel and innovative teaching interventions were identified by this research. These included a complicated four-modality intervention that embraced aspects of the VARK learning style model and a cutting and pasting exercise to help the identification of muscles spacially. However, such interventions would have to be considered as an adjuct to the basic teaching methods as they are time-consuming both in their application and the set up required prior to the intervention. While such complex multi-modal interventions are difficult to implement students can use innovative simpler tools to learn anatomy. One example of this is a ball full of pieces of folded paper with questions about muscles on them. The questions are pulled out randomly and the student attempts to answer the questions. Students could use this as an aid to self-study.

This research identified that the regional approach to gross anatomy teaching was most utilised in South African health science faculties. The evidence suggests that a regional approach is most suited to the use of dissection. Half of the surveyed faculties in this country reported using this pedagogy to teach PT students and the high number of faculties

using the regional approach may be partly associated with that finding. As per the recommendations in the literature it could be suggested that the regional approach should be continued in the faculties that use dissection but elsewhere a mixed approach incorporating aspects of regional and systemic methodology could be introduced especially where problem-based learning is predominant.

With regards to gross anatomy course content for PT students musculature, the upper limb, lower limb, back region and thorax were all rated as important inclusions. Qualified South African physiotherapists found the afore-mentioned regions important but also thought the brain and spinal cord to be essential inclusions. Overall the abdominal region was considered covered in too much detail across the board. This would suggest that definitive content for a gross anatomy curriculum for PT students should not be difficult to decide and may be one aspect of an overall unified curriculum where consensus can be reached easily throughout South Africa. However, It was seen that the plastinated specimens and anatomical models available across surveyed faculties with the exception of the thorax and musculature were, in general, more suited to the needs of medical or dental students. This may be due to the fact that plastinated specimens and anatomical models are often shared between medical and therapeutic sciences divisions and have to serve the needs of all students. This matter needs to be addressed to ensure that PT students have enough relevant material appropriate to their learning requirements.

Staff characteristics have been described at length in all four of the studies in this thesis. Clinical relevancy has been raised as an essential component in a health care curriculum. In this regard, the one point that is perhaps a little contentious is that of PT clinicians teaching anatomy to the PT student group but it is quite clear that at least some of the staff should have PT clinical knowledge as students perceive this advantageous to the relevancy of the delivery of anatomical information to their particular healthcare discipline. In order to resolve this matter it would be beneficial if qualified physiotherapists were to be included in the gross anatomy staff compliment. This can be most easily accomplished if they are brought in as teaching assistants or part-time lecturers. However, although qualified physiotherapists will have retained some anatomical knowledge from their undergraduate student years it should be recommended that they undergo some form of anatomy revision and serve an internship working with anatomists to reach the necessary anatomical standard before teaching the students.

Horizontal integration of clinical cases should be included into a gross anatomy curriculum. Students that are faced with the huge burden of learning anatomy often lose sight of the

bigger picture which is that this subject will equip them for future clinical competency and enable them to treat their patients in an optimal way. Therefore, it is extremely important that there is communication between the PT department and anatomical sciences so that timing of content in each discipline is structured to compliment each other. Furthermore, student clinical visits to see patients with relevant conditions pertaining to current anatomy learning in the early stages of their course would inprint anatomy knowledge and help with its retention.

The matter of vertical integration should also be addressed where students, particularly in their fourth year, have an opportunity to revisit certain pertinent anatomical regions in order to enable them to maximise the clinical relevancy of their gross anatomy.

The timing as to when a gross anatomy programme is held within the overall undergraduate PT course is debatable. The idea of an intergrated two-year model that is used in two of the South African faculties proved to be well received by the qualified physiotherapists who gave their opinions in this thesis. This might be a better scenario to alleviate some of the psychological pressure in relation to perceived anatomy overload. The two- year option may also allow for the incorporation of more anatomical terminology to be introduced in the first year to familiarise the students with thinking in an anatomical way. However, this topic would have to be widely discussed before any change could be suggested for a unified curriculum. The matter would probably be a hard one to resolve as the faculties structure their overall PT courses based on different criteria. This point once again identifies the fundamental diversity that is found in South African health science faculties regarding gross anatomy for the undergraduate PT student body and is something that would have to be decided at the highest levels of faculties and educational and medical governmental structures.

The identification of a possible ‘physiotherapist personality’ coupled with the fact that consideration has to be given to the realisation that the vast majority of PT students are young and immature may impact on how such students learn anatomy and what methods of instruction would best suit their needs. The identification of similar learning styles over two student cohorts may also dictate pedagogy that will work best for this student body. However, this information was only garnered from specific targeted sources and it may be necessary to expand this information using a national survey on the topic.

Dissection and prosection observation have been shown to develop a student’s professional persona and helps with the understanding of ethical concepts such as the dignity of life. An important outcome of this research that was not originally expected was

the identification of the detrimental effect of cadaver dissection and in some cases observation of prosected cadaveric material on the student psyche. In this regard, students should have access to psychological counselling to assist in dealing with this matter. Furthermore, the way in which the introduction to the cadaver and thre desensitisation process is handled can be extremely important to the students' wellbeing. It would be beneficial if a brief survey of students' perceptions regarding how they think they would cope with the experience was undertaken prior to exposure to the cadaveric remains. This would help to identify and assess possible problems that could arise and develop strategies to counteract them.

Interesting inclusions that arose were:

- The 'physiotherapist's personality' that is strong and analytical, likes to make lists, likes to brainstorm and once shown how to do a technique will get on and carryi it out.
- The fact that the maturity of the student impacts on how they approach learning.
- Students seemed to be surprised that there was so much self study involved
- Many of the qualified physiotherapists felt that all anatomical content should be covered.
- Some students seemed to be oblivious to the fact that taking photographs of cadavers was unethical and prohibited.

It can be concluded that the South African undergraduate PT gross anatomy programmes available presently are very varied in content. This research pinpointed that the introduction of computer assisted learning in certain faculties is lagging behind other faculties and the global scenario due to financial constraints. Although dissection is still the preferred pedagogy for many reasons as outlined in this thesis the use of computer-assisted learning as an adjunct pedagogy has to be considered to perhaps utilise the time available for anatomy more economically. Students are generally in their early twenties and have experience of technology and therefore cope well using this format. However, the fact that students are young may influence how they learn and the maturity with which they approach studying. The problems arising from increasing numbers of students being admitted to anatomy programmes will have to be addressed both in relation to types of pedagogy available and size of facilities to house the necessary tools to teach the course. Instructors that teach dissection have to be made aware of the fact that some students may have a moderate to extreme negative reaction to cadaveric dissection. Finacial constraints may negatively dictate the way forward for gross anatomy education. However, with enthusiastic motivated staff many of the barriers to successful gross anatomy education of this student body can be overcome.

Figure 8.1 below is a schematic representation of elements to be incorporated into an overall unified gross anatomy curriculum for undergraduate PT students in South Africa based on the conclusions reached in Chapter 8 of this thesis.

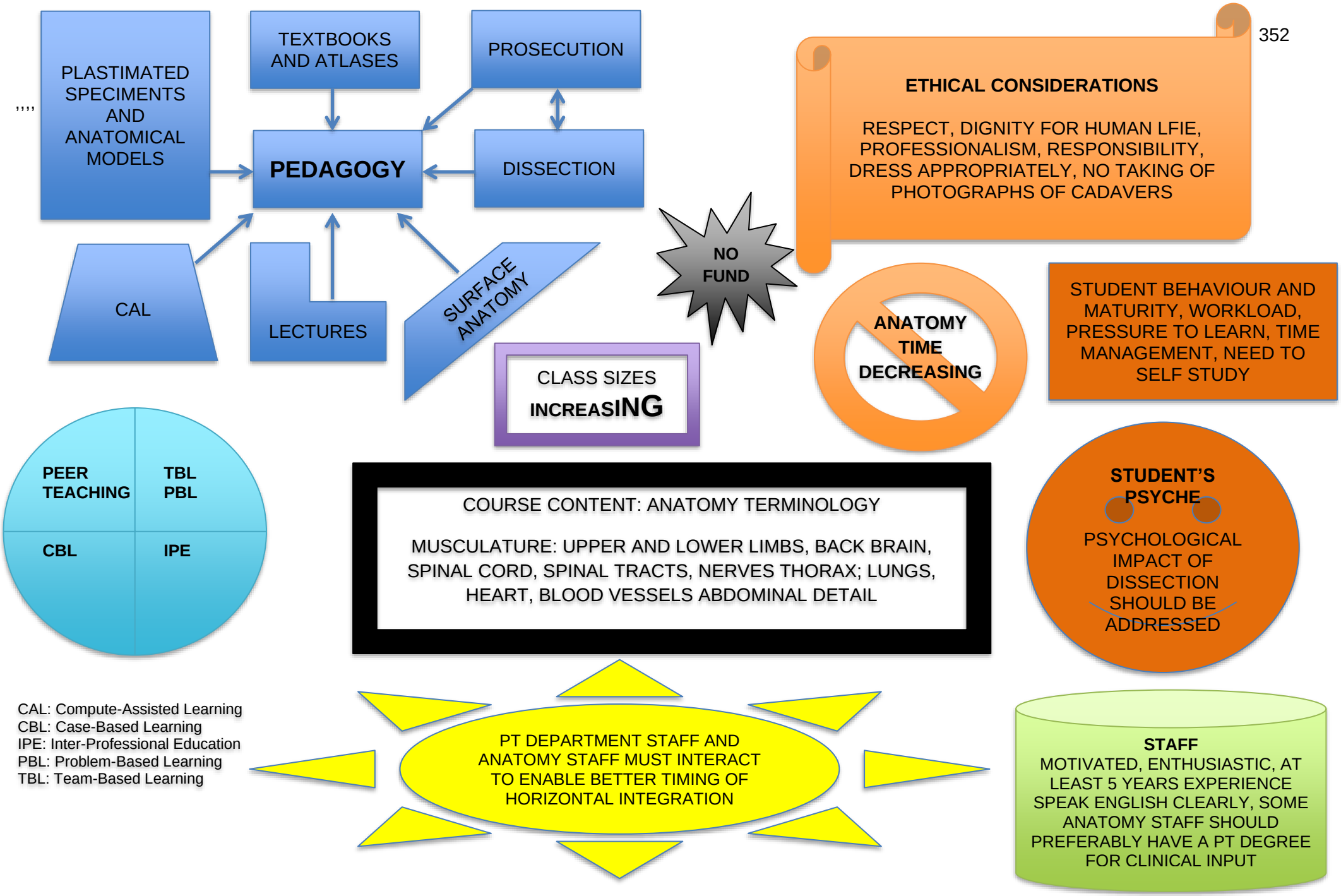

Figure 8.1 Schematic of the Elements of a framework for a Unified Gross Anatomy Curriculum for PT Students in South Africa

8.1 LIMITATIONS OF THE RESEARCH

It was decided by all three reviewers at the outset of the collection of the literature for the scoping review in Study 1 that literature pertaining to assessment of students' performance in their respective anatomy programmes would not be included. When the design of the 2016 REDCap national survey was decided one question (Question 40) on the types of examinations was included. As this was not a major focus of the data collection for the thesis no new strategy for scoping review literature collection was implemented. However, during the write up of the literature review of this thesis it was noted in this regard that Wojtczak (2002) in describing features of a curriculum added that methods of assessment should be included. Two articles namely Fabrizio (2013) and Zhang et al. (2013) in this regard were omitted from this research. This could possibly be cause for limitation in the overall suggested unified curricular conclusions.

The sample size for the lecturer groups in both consecutive cohorts of Study 4 were very small. Even with pooling of data all three of the second cohort particpants were included in the first cohort and this may have influenced the strength of the conclusions made in this study.

CHAPTER 9

9. RECOMMENDATIONS

9.1 CURRICULAR AND PEDAGOGICAL RECOMMENDATIONS

As this research has shown dissection is still the preferred pedagogy for the ‘hands on’ experience so important for PT students to prepare them for clinical practice and it should be implemented wherever possible. Prosection should be continued in faculties with fewer available cadavers but attention must be paid to avoiding high student to cadaver ratios. Either dissection or prosection should be preferably used in faculties where adequate computers are not available but cadavers can be sourced. The matter of lack of access to computer technology in some faculties should be addressed to facilitate the use of computers as an adjunct pedagogy.

The matter of space for the conduction of gross anatomy education is going to have to be prioritised by health science faculties soon as the expansion or renovation of facilities to cater for a larger student body will become critical. The main problem in this regard will be financial as universities in South Africa are already facing numerous fiscal restraints. This will require motivation on behalf of anatomical sciences schools and departments to push for more financial assistance. In this regard further urgent investigation into what is required to address this imminent crisis has to be carried out by relevant bodies. This research could be used to form a basis for the argument and help strengthen the case for change and should be brought to the attention of Health Science Faculties and respective anatomical departments or schools, PT departments in health science faculties, the SASP, the HPCSA and the Department of Higher Education and Training (DHET) in South Africa.

The use of rotational dissection or prosection strategy should only be regarded as a temporary measure to address the problem of avoiding dissection or prosection groups of more than eight students as it is not an optimal solution. The effective longterm measure has to be the creation of new facilities designed to accommodate the growing student body requirements.

The use of tutorials where larger classes are divided into smaller groups should be encouraged. Peer teaching and team-based learningcan be incorporated into such sessions. These should target specific areas of anatomical importance and may allow for the incorporation of some surface anatomy sessions and should also highlight clinical relevance of the included material. These sessions should not be lectures but should develop and encourage student interaction with each other and the instructor.

The instructor should act as a facilitator. Tutorials should last a maximum of one hour to maintain student concentration.

Functional anatomy should be a requisite for inclusion and perhaps horizontal or vertical integration can be incorporated into this aspect of anatomy education. Furthermore, the use of analysis of functional movements using anatomy knowledge can be incorporated into tutorials.

Some faculties have an integrated anatomy and physiology programme over two years. This also allows for anatomical terminology to be introduced in the first year. The positioning and length of the gross anatomy course should be investigated further.

While novel anatomy interventions such as multi modal learning or MCOE are fun for students to participate in they require much preparation and planning by staff and it may just not be possible to include them in place of more structured and tried and tested teaching methods during the week. Perhaps a weekend workshop with voluntary student participation could provide this type of fun activity while revising elements of the anatomy course objectives.

Interprofessional education between physiotherapy students and students of closely allied disciplines should continue to encourage teamwork in future clinical practice. However, the relevance of the gross anatomy course content to the physiotherapy discipline specifically should not be ignored and case study and clinical content should be relevant to the physiotherapy discipline.

Ethical standards should always be upheld and the use of cell phones in laboratories banned to deter the taking of photographs of cadaveric material. Dress codes should be observed in laboratories. Students should be given clear instructions in this regard before commencing the anatomy programme.

The use of plastinated specimens or anatomical models, textbooks and atlases should be continued. The former anatomical tools should be upgraded to include more specimens pertinent to the PT student requirements as outlined in this thesis. Textbooks and atlases can be utilised in the printed, phone or tablet format. However, as phones and tablets should be banned from laboratories the use of devices should be limited to other spaces.

Horizontal integration that includes the use of anatomy in conjunction with PT techniques such as testing of the anterior cruciate ligament on cadavers or case-based learning where students are shown cases in hospital that relate to the anatomy content should be incorporated into the PT and anatomy curricula. These should take place to afford maximum clinical input relative to the anatomical content.

Vertical integration where PT students in the third or fourth year are given an opportunity to revisit the anatomy laboratory for certain revision sessions would reinforce earlier anatomical knowledge. This would be especially useful in relation to neuro-anatomy revision. Timing of the exercise will be critical and this will involve cooperation between the anatomy and PT departments to ensure that it occurs at the optimum time in relation to both programmes.

9.2 RECOMMENDATIONS FOR FUTURE RESEARCH

Study 4 (Chapter 6) of this thesis gathered useful data regarding the matching of gross anatomy PT students' GRLSS learning styles with their anatomy lecturers GRTSS teaching styles. However, while the pooling of data in Study 4 due to small student and lecturer sample sizes in both 2015 and 2016 afforded more reliable outcome measures it would be better if a longitudinal study, using a larger sample of both students and lecturers, were to be carried out to confirm the findings of this thesis.

Attention should be paid to the effect that dissection or observation of prosected cadavers has on a student's psyche. Research should be undertaken to assess how this impacts the students ability to cope with dissection or prosection and the effect of this phenomenum on a student's academic performance.

A survey to determine the number of PT practitioners teaching gross anatomy nationally should be undertaken and students should also be surveyed regarding their perceptions and opinions on the use and input of such gross anatomy staff.

An early clinical exposure intervention should be undertaken where half the undergraduate students learning gross anatomy (intervention group) are randomly allocated into smaller groups in order to experience ward visits where they interview and assess five patients with conditions pertinent to the gross anatomy region that they are learning at that time. The rest of the class (control group) have case presentations on the same clinical conditions in a team-based practical in the anatomy department. A survey on the students' perceptions of the intervention should

be undertaken and the end of region examination scores should be compared to evaluate the outcomes of the intervention.

A follow-up national survey should be carried out in three years time to reassess whether there has been more unification of the gross anatomy programmes for undergraduate PT students in South Africa.

APPENDIX 1

PAPER 1: SHEAD D, ROOS R, OLIVIER B, IHUNWO AO 2016 GROSS ANATOMY CURRICULA AND PEDAGOGICAL APPROACHES FOR UNDERGRADUATE PHYSIOTHERAPY STUDENTS: A SCOPING REVIEW PROTOCOL *JOANNA BRIGGS INSTITUTE (JBI) DATABASE OF SYSTEMATIC REVIEWS AND IMPLEMENTATION REPORTS* 14(10): 98-104.

The formatting of the content of this thesis paper is aligned with the publication requirements of the specific journal. The table has been inserted at the appropriate position in the paper.

Background

Anatomy is the foundation stone of medical education internationally. [1,2] Rituals for the dead in ancient Egypt incorporated a crude form of dissection and in 1235 the anatomy curriculum was born when the first medical school was opened in Salerno in Italy.[1] In the 16th century, Vesalius was instrumental in fighting to get mandatory human anatomy dissection into the medical curriculum.[2] Preclinical medical education in the United States of America in the 1900s was dominated by anatomy. [3]

Recently the teaching of human anatomy is influenced by less available instructional time, [3] financial constraints and fewer suitably qualified anatomy teachers. [4-6] However, it was reported that suitably qualified staff/student ratios across the African continent were comparatively high when compared to those in the Western world.[7] The availability of fewer cadavers has led to changes in the approach to gross anatomy pedagogy. A 2010 article reported on the percentages of cadaveric donations in the United States of America, the United Kingdom and the African continent and how this influences the use of cadavers in gross anatomy education.[8] Furthermore, the difficulties arising from the practical management of cadavers and the religious and cultural beliefs of some students are creating challenges pertaining to the use of cadavers in anatomical education. [9] Since the beginning of the 21st century, these time constraints have seen a decline in the standard of anatomy teaching outcomes: a decrease in medical students' anatomical knowledge with resultant decreased clinical competency and an increase in the concern for the safety of patients treated by such clinicians. [1,2] In particular, work done by the Van der Vleuten group [10] who looked at the level of Dutch medical students' knowledge of case-based anatomy concluded that the students tested did not know enough about human gross anatomy. In addition, it was reported that between 1995 and 2000, there was a seven-fold increase in claims associated with anatomical mistakes in the United Kingdom. [11] However, the results of a South African survey of second year dental students done in 2015, where there were limited human

resources for teaching and increased use of technology, showed that the students learning of anatomy was not adversely affected by those limitations. [12]

Information relating to the effect of these instructional anatomy time constraints on the quality of physiotherapy clinical practice specifically has not been documented in the available literature.

A survey of undergraduate physiotherapy students at the Universities of Almeria´ and Jae´n in Spain found anatomy to be a ‘‘highly appropriate’’ inclusion in their course. [13] By its very name, physiotherapy requires that its students and practitioners become well versed in the way in which the body moves in an optimally functional way. To achieve this goal, pre-clinical physiotherapy students have to know the musculoskeletal components of the human body in detail. They have to know how neuro- anatomy impacts on the functioning of these components and be able to discern whether, for example, a specific lobe of the lung is functioning optimally and direct their treatment accordingly. In many different ways, knowledge of human anatomy will play an integral role in the competency of a physiotherapist in future clinical practice.

The term pedagogy in the gross anatomy context is defined as teaching methodologies such as dissection, didactic lecturing and computer instruction that are used to improve the anatomy learning experience. [3] It has been stated that human dissection is the preferred gross anatomy pedagogy. [14,15] In 2006, it was reported that dissection is important as the basis for the development of medical professional ethics. [16] The inclusion of dissection as part of the gross anatomy pedagogy continues, but in many cases it has been decreased in line with time constraints brought about by the teaching of extra topics included in the curriculum and the use of new methods of teaching. In some instances, it has been retired completely in favour of modern technological applications such as interactive multimedia and digital imaging. [2] However, in 2011 second year medical students were surveyed to assess their perceptions of learning anatomy through the use of dissection alone. Positive feedback with regard to the understanding of anatomy in more depth and increased anatomical knowledge was recorded.[17] New types of gross anatomy pedagogy are being considered in the hope that the subject will be taught within the limitations previously mentioned, while still maintaining a high standard of anatomical education overall. Three-dimensional concepts are difficult to visualize with traditional anatomical teaching, [18] while simulation by using easily accessible 3D models [19] and the construction of anatomical models are ways to add to a student’s perception of the functionality of anatomy. [20] ‘‘Muscle cutout and paste exercises’’ can improve learning outcomes in health sciences students. [21] In 2012, a survey of 280 undergraduate medical and anatomy students about their opinion on the use of plastinated

specimens in the anatomy lab found that 75% of the respondents considered this a very useful anatomical tool. [22] Furthermore, the use of such specimens, together with cadaveric specimens, was proposed by 78% of the respondents. [22] Computer- assisted instruction can be used alone [23-25] or to compliment traditional instruction for physiotherapy students as well as medical students. [2,26,27] Full body digital X-ray images can be used to enhance a student's ability to locate anatomical structures in the surface anatomy context. [28] With regards to other adjunct learning techniques that can be incorporated into an undergraduate physiotherapy anatomy program, there are asynchronous online discussion groups, [29] remedial teaching via constant remedial visual internet input, [30] team-based learning programs [5,31] and the rotation of student groups between dissection and peer demonstrations that have been shown to produce positive outcomes [6,32] with no decline in practical examination performance. [33] Peer teaching in the gross anatomy laboratory involving undergraduate physiotherapy students has also been documented [34,35] and can be used together with an audience response system to enhance teaching methods for a gross anatomy class. [36] A study in Brazil reported on the use of a peer-mentoring program in an inter-professional and interdisciplinary allied health intervention. It reported that the students who participated achieved better academic results than those who had not participated. [37] It has been stated that both medical students and physical therapy students require knowledge of anatomy, and these two groups of students integrate well for inter-professional education (IPE) in a gross anatomy dissection course. [38] In recent years, in physiotherapy gross anatomy education, there has been an increase in the use of IPE [39] and its application as a near-peer intervention to foster IPE teamwork in gross anatomy. [40] Furthermore, an IPE study involving medical and physical therapy students, where students from one of the academic programs were responsible for teaching a part of the human body that they had dissected to the other group and vice-versa, resulted in useful interprofessional bonds established and the appreciation of collaborative learning and teamwork.[41]

Systematic curriculum development addresses those to be taught, what the content will be, how it will be taught and the interaction between subject matter. [42] Gross anatomy course designs have to consider clinically relevant, integrated systems and a learning outcomes-based approach in the development of a course curriculum. [43] A number of authors have suggested that a gross anatomy curriculum for physiotherapy students should incorporate input from physiotherapists [44,45] and be clinically relevant to physiotherapy practice. [46,47] The different types of physiotherapy degree programmes offered worldwide are designed to accommodate the needs that pertain to the specific physiotherapy practice in each of those countries. [48] In South Africa, physiotherapists assume the role of first-line practitioners. [49] These physiotherapists are permitted to have access to patients without having to have them referred to by another healthcare professional and can therefore work independently, can offer a diagnosis pertaining to the patient's illness within their scope of practice and can refer

a patient to a specialist clinician if they feel that the condition is beyond their scope of practice. They can also write sick notes for patients and administer prescribed medicines. [50] First-line physiotherapy practitioners are also found in Australia [51] and in New Zealand [52] but in many countries, including the United Kingdom, physiotherapists have not been given first-line status.[53]

A preliminary search was undertaken in the, Academic Search Complete, CINAHL, Cochrane Library, Education Search Complete, ERIC, PEDRO PubMed and SCOPUS databases to establish whether systematic or scoping reviews published or underway on this topic already exist and none were found. This fact, together with the aforementioned points, serves to highlight problems with regard to the teaching of gross anatomy. It is still not clear what teaching style or which combination of styles should be included in an anatomy curriculum framework for undergraduate physiotherapy students. The choice of gross anatomical curriculum, type of gross anatomy pedagogy and method of delivering the information to undergraduate physiotherapy students not only to prepare them for examination but also for clinical competency seems dependent on the interaction of many factors.

Inclusion criteria

Types of participants

The current review will consider participants who are undergraduate physiotherapy students enrolled in a gross anatomy course at a university level and participants who are anatomy educators, physiotherapy educators or clinicians who have participated in research relating to gross anatomy curriculum and/or pedagogy for undergraduate physiotherapy students.

Concept

The current concepts of interest are gross anatomy curricula and pedagogies available for the education of undergraduate physiotherapy students. Within the existing literature, a number of different terms have been identified that pertain to this concept overall. Below follows a non-exclusive list of potential topics to be considered for inclusion:

Gross anatomy pedagogy looking at dissection, prosection, the use of anatomical models, body painting, living anatomy and spatial gross anatomy muscle relationships.

Computer-assisted instruction/learning including the concept of advanced 3D visual learning and asynchronous online discussion forums.

Learning management and types of education including: peer group education, vertical integration, IPE, problem-based learning and case- based learning.

Curricular developments such as the possibility of the development of a global gross anatomy core syllabus for allied healthcare students.

Outcomes measured in relation to types of gross anatomy pedagogical interventions and curricular changes for the student population under review.

Context

The current scoping review will be conducted using information gleaned from the available literature that looks at gross anatomy programmes for undergraduate physiotherapy students studying at universities.

Types of sources

All available qualitative papers, mixed methods studies, descriptive studies, quantitative descriptive studies, randomized control trials, systematic reviews, meta-analyses and conference papers or abstracts from such papers on the gross anatomy curriculum and pedagogy for undergraduate physiotherapy students will be eligible for inclusion.

Search Strategy

Published and unpublished studies in all languages will be considered for inclusion. The inclusion date for studies is open-ended, and this is dictated by the dearth of information on this topic. In this regard, the term open-ended can be defined as having no predetermined date limits to the database search to retrieve as much information as possible about the topic under review. This is due to the fact that there is little specific information relating singularly to undergraduate physiotherapy students**.** Usually studies of this population of students are in combination with medical or other health sciences students, and the collected data do not necessarily differentiate between the groups. Hence, a protracted search is necessary to retrieve all relevant data. Eventually, the date of the earliest and latest papers will be ascertained through the literature search process. A three-step search strategy will be used in this review. An initial limited search will be conducted using the MEDLINE (PubMed) and SCOPUS databases. An analysis of the retrieved titles and abstracts will then be undertaken to identify key words and index terms used to describe the article. Second, a search using all the identified keywords and index terms will be undertaken across all included databases. Finally, the reference lists of all identified articles and reports will be searched for additional relevant studies. The authors of primary studies will be contacted if further information is needed. Grey literature will be sourced using Google.

A search will be undertaken in the following databases for published studies:

Academic Search Complete CINAHL

Cochrane Database of Systematic Reviews Education Search complete

ERIC PEDRO

PubMed SCOPUS.

A search will be undertaken in the following databases for unpublished studies:

Google

The American Association of Clinical Anatomists website/conferences

The Anatomical Society of Southern Africa web site/ conferences

University of the Witwatersrand website library archives for theses on the topic
Key words and key phrases to be used in the initial search will include the following:
Undergraduate; students; physiotherapy; physical therapy; gross anatomy; pedagogy; teaching methods; curriculum; education; dissection.

Consideration for inclusion

As this is a scoping review, no assessment of methodological quality will be performed. Two independent reviewers will assess whether a study should be included. If these two reviewers cannot reach consensus on the inclusion of a study, a third independent reviewer will be called upon to resolve the matter.

Data Extraction

Two independent reviewers will extract data (qualitative and quantitative) from each study relevant to the review question. The results will be charted to record the key information of the source that is relevant to the review question. A data extraction instrument for this scoping review has been devel- oped (Appendix I). However, this may be further modified at the review stage. Key information that might be charted include the following:

Author(s)
Year of publication Type of study/design Location of study
Aim(s) or purpose of study Population and sample size
Description of anatomy teaching methods and/or type of curriculum in the study
Length of the intervention (if applicable) Outcome(s) measured
Results
Conclusions relevant to scoping review question

Presentation of the results

The number of studies found, included and excluded will be shown in an adapted PRISMA flow-diagram.[54] Extracted results will be presented in the form of a table the same or similar to that already developed for this protocol document. A summary of the results will incorporate the aims and purposes of the reviewed studies methodologies applied and a synopsis of the results obtained relevant to the review questions. Conclusions will be made and suggestions will follow as to possible systematic review questions arising from those conclusions.

Acknowledgements

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- **DATA EXTRACTION INSTRUMENT**

Authors and year of publi-cation	Type of study/ design	Location of the study	Aim(s) or purpose of the study	Population and sample size	Description of anatomy teaching methods and/or type of curriculum in the study	Length of intervention (if applicable)	Outcome(s) measured	Results	Conclusion(s) relevant to scoping review question

APPENDIX 2

- **ETHICAL CLEARANCE CERTIFICATE FOR THE THESIS**

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Shead

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H15/04/12**
PROJECT TITLE	Dissecting the gross anatomy curriculum and pedagogy for South African physiotherapy students
INVESTIGATOR(S)	Ms D Shead
SCHOOL/DEPARTMENT	Therapeutic Sciences/Physiotherapy
DATE CONSIDERED	17 April 2015
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	7 May 2017

DATE 8 May 2015 **CHAIRPERSON** (Professor T Mtiani)

cc: Supervisor : Dr R Roos

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

D A Shead
Signature

22,05,2015
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX 3

- **TITLE APPROVAL LETTER OF THE THESIS**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Ms Thokozile Nhlapo
E-mail: thokozile.nhlapo@wits.ac.za

03 September 2015
Person No: 7239588
PAG

Ms DA Shead
Postnet Suite 363
Private Bag X1
Melrose Arch
2076
South Africa

Dear Ms Shead

Doctor of Philosophy: Approval of Title

We have pleasure in advising that your proposal entitled *Dissecting the gross anatomy curriculum and pedagogy for South African physiotherapy students* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

APPENDIX 4

- **PERMISSION TO CONDUCT RESEARCH AT THE UNIVERSITY OF THE WITWATERSRAND**

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

OFFICE OF THE REGISTRAR

TO WHOM IT MAY CONCERN

"Dissecting the gross anatomy curriculum and pedagogy for South African physiotherapy students"

It is hereby confirmed that the enclosed research material has been distributed in accordance with the University's approval procedures for such a project. Please be advised that it is your right to withdraw from participating in the process if you find the contents intrusive, too time-consuming, or inappropriate. The necessary ethical clearance has been obtained.

Should the University's internal mailing system be the mechanism whereby this questionnaire has been distributed, this notice serves as proof that permission to use it has been granted.

Students conducting surveys must seek permission in advance from Heads of Schools or individual academics concerned should surveys be conducted during teaching time.

Carol Crosley
University Registrar
30th April 2015

Private Bag 3, WITS 2050, South Africa | **T:** +27 11 717 1201/2 | **F:** +27 11 717 1217 | **E:** registrar@wits.ac.za

APPENDIX 5

PERMISSION FROM THE PRESIDENT OF THE ANATOMICAL SOCIETY OF SOUTHERN AFRICA (ASSA) TO CONDUCT RESEARCH IN DEPARTMENTS OF ANATOMY THROUGHOUT SOUTH AFRICA

ASSA AVSA

Anatomical Society of Southern Africa
Anatomiese Vereniging van Suider Afrika

9 March 2016

To whom it may concern

On behalf of the Anatomical Society of Southern Africa (ASSA), and in my capacity as president of this association, I give permission for Ms D Shead to send out questionnaires to members of ASSA for purposes of her post-graduate study.

Yours sincerely,



Prof M Steyn

President: ASSA

maryna.steyn@wits.ac.za

APPENDIX 6

INFORMATION FOR LECTURERS WHO COORDINATE THE UNDERGRADUATE PHYSIOTHERAPY STUDENT GROSS ANATOMY TEACHING PROGRAMME.

Dear Colleague,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

I would like to invite you to participate in an online survey and would much appreciate your participation.

What type of online survey?

I am conducting an online survey that looks at the content and teaching methods used in the gross anatomy course that you teach to undergraduate physiotherapy students at the… Name of the particular University inserted here….

What is the significance of this part of the study?

The purpose of this survey is to determine the current gross anatomy curriculum and teaching methods offered to undergraduate physiotherapy students in South Africa. I am trying to establish where we are apropos global trends and contribute to the body of knowledge on this topic.

What would you be expected to do?

You will receive the online survey on **11 March 2016** and would be required to return the completed survey to me by **11 April 2016.** The survey is returned to me by following the instructions at the end of the survey document. Your participation in the survey would take approximately 30 minutes.

Important participation facts

Participation in this survey is voluntary. If you submit a completed survey document to me it will indicate that you consent to the information you provide in the survey being used in my study. Because your name will not be required or appear on the survey document your answers will be considered anonymous and your confidentiality will be guaranteed. If you want a summary of the research it will be provided on request.

Ethical clearance

The University of the Witwatersrand ethical clearance number for the research is: R14/49 Shead Protocol number H15/04/12. I have also received gatekeeper permission to distribute the survey from the Anatomical Society of South Africa (ASSA).

My contact details

If you need further information I can be contacted at dots@icon.co.za or Dorothy.shead@wits.ac.za or on 082 491 7817.
Kind regards
Dorothy Shead
MSc Physiotherapy (WITS)

APPENDIX 7

- **GROSS ANATOMY SURVEY DOCUMENT**

Confidential

Gross anatomy survey: What is the gross anatomy curriculum and pedagogy for undergraduate physiotherapy students in South Africa?

Before completeing this survey please refer to the information sheet that has been emailed to you as it will explain who is conducting this research, why it is being undertaken and what your ethical rights are regarding participation in this survey.

Your participation in this gross anatomy survey is deemed as informed consent.

Please respond to the following questions regarding gross anatomy teaching methods and curriculum offered to undergraduate physiotherapy students studying at your Health Sciences Faculty.

1. How many people, including lecturers,teaching assistants and tutors, are teaching gross anatomy to undergraduate physiotherapy students in your faculty?

- ◯ 0-5
- ◯ 6-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21-25
- ◯ Other

(If you have chosen other as your answer please elaborate)

Number of people teaching gross anatomy to undergraduate physiotherapy students? _____

2.Within which of the following categories, according to their level of education (by qualification), do these teaching staff fall? Please tick as many boxes as necessary to answer the question.

- ☐ PhD
- ☐ Masters
- ☐ Honours
- ☐ Bachelor degree
- ☐ Other

(If you have chosen other as your answer please elaborate)

level of education _____

3. What is the average number of years of experience, in teaching gross anatomy to undergraduate physiotherapy students, among those teaching in your programme?

- ◯ average of 1 year
- ◯ average of 5 years
- ◯ average of 10 years
- ◯ average of > 11 years

4. How many undergraduate physiotherapy students are in your gross anatomy class?

- ◯ < 30
- ◯ 31-50
- ◯ 51-70
- ◯ 71-90
- ◯ 91-120
- ◯ >120

5.How many of these students are repeating the gross anatomy course for the second time?

- ◯ 0-10
- ◯ 11-20
- ◯ 21-30
- ◯ 31-40
- ◯ Other

(If you have chosen other as your answer please elaborate)

Number of repeating students? _____

6.What is the ratio of teaching staff to undergraduate physiotherapy students taking the gross anatomy course in your faculty?

_____

7. What is the ratio of males to females teaching gross anatomy to undergraduate physiotherapy students in your faculty?

_____

8. Do students other than physiotherapy students use the dissection hall?

- ○ Yes
- ○ No

8a. If other students use the dissection hall who are they?

- ☐ Medical students
- ☐ Health sciences students
- ☐ Dental students
- ☐ Pharmacy students
- ☐ Occupational therapy students
- ☐ Nursing students
- ☐ Other

(If you have chosen other as your answer please elaborate)

Student group?

_____

8b. How many direct contact hours per week do your physiotherapy students spend in gross anatomy lectures?

- ○ < 1 hour
- ○ 1-2 hours
- ○ 3-4 hours
- ○ 5-6 hours
- ○ >6 hours

8c. How many direct contact hours per week do your physiotherapy students spend in the gross anatomy dissection hall/lab?

- ○ < 1 hour
- ○ 1-2 hours
- ○ 3-4 hours
- ○ 5-6 hours
- ○ >6 hours

9. Are the physiotherapy students allowed additional 'OPEN LAB " time to work in the dissection halls on their own or in groups?

- ○ Yes
- ○ No

(If you answered yes please elaborate)

If you answered YES to the above question how many hours per week are offered?

- ○ < 1 hour
- ○ 1-2 hours
- ○ 3-4 hours
- ○ 5-6 hours
- ○ > 6 hours
- ○ N/A no open time

10. Into how many blocks (semesters) is the gross anatomy course divided per year?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ Other

(If you have chosen other as your answer please elaborate)

How many (blocks) semesters?

_____

11. How many weeks are in each (block) semester?

_____

12. What method(s) of teaching are used in your gross anatomy labs for physiotherapy students? Please tick every method you employ. Later pages will ask questions regarding your choices.

- ☐ Dissection
- ☐ Prosection
- ☐ Computer-based learning
- ☐ Plastinated models
- ☐ Other

(If you have chosen other as your answer please elaborate)

What teaching methods?

_____

DISSECTION

If you choose dissection as a teaching method please answer the following question. If you do NOT use dissection as a teaching method please scroll to question 18 and continue

13. How many direct contact hours per week do your physiotherapy students spend doing gross anatomy dissection?

- ◯ 0-2 hours
- ◯ 3-4 hours
- ◯ 5-6 hours
- ◯ Other

(If you have chosen other as your answer please elaborate)

How many hours?

_____

14. How many cadavers or cadaver sections are available for physiotherapy student dissection?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ Other

(If you have chosen other as your answer please elaborate)

How many cadavers/cadaver sections?

_____

15. How many physiotherapy students are assigned per cadaver?

- ◯ 1-3
- ◯ 4-6
- ◯ 7-9
- ◯ 10-12
- ◯ Other

(If you have chosen other as your answer please elaborate)

How many physiotherapy students/cadaver?

_____

16. Has your institution always used dissection in the instruction of lab material in the gross anatomy course?

- ◯ Yes
- ◯ No

17. If you have NOT always used dissection , please comment on why your institution made the change in teaching methods?

_____

PROSECTION

If you choose prosection as a teaching method please answer the following questions. If you do NOT use prosection as a teaching method please scroll to the section on COMPUTER-BASED LEARNING (NO or YES) as applicable

18. Who completes the prosections used by the undergraduate physiotherapy students in the gross anatomy lab?

- ☐ Lecturers
- ☐ Lab instructors
- ☐ Teaching assistants
- ☐ PhD students
- ☐ Masters students
- ☐ Tutors
- ☐ Other

(If you have chosen other as your answer please elaborate)

Who completes the prosections? _____

19. How much of the time in the dissection hall is spent on anatomy practicals with prosections?

- ◯ < 1 hour
- ◯ 1-2 hours
- ◯ 3-4 hours
- ◯ 5-6 hours
- ◯ > 6 hours

20. Do you have smaller,separated dissections from the cadavers? i.e. arm,leg, pelvis etc

- ◯ Yes
- ◯ No

21. If you do not use separate dissection how many full body prosected cadavers are available in the lab?

- ◯ 1-5
- ◯ 6-10
- ◯ >11
- ◯ NA-we use separate dissection
- ◯ Other

(If you have chosen other as your answer please elaborate)

How many full body prosections? _____

22. Do your physiotherapy students have the opportunity to dissect later in their curriculum?

- ◯ Yes
- ◯ No

23. If your students do have an opportunity please describe what opportunities for dissections are available. If you have answered NO to the previous question please just write N/A in the answer box.

_____

24. Has your faculty always used prosection in the instruction of gross anatomy?

- ◯ Yes
- ◯ No

25. If you have NOT always used prosection please comment on why your institution made the change in teaching methods

_____

COMPUTER-BASED LEARNING (NO)

If you do NOT use computer-based learning as a teaching method please answer question 26 and then scroll to question 30.

26. Why does your institution NOT use computer-based learning?

_____

COMPUTER-BASED LEARNING(YES)

If you choose computer-based learning as a teaching method please answer questions 27-29.

27. What programme does your institution use?

_____

28. Could you please give 3 reasons why your course chose to use this programme

_____

29. How many (blocks) semesters has your institution used this programme?

- ○ 1
- ○ 2
- ○ 3
- ○ Other

(If you have chosen other as your answer please elaborate)

Number of blocks (semesters)?

_____

PLASTINATED MODELS

If you choose plastinated models as a teaching method please answer the following questions. If you do NOT use plastinated models as a teaching method please scroll to the section on LIVING/SURFACE ANATOMY.

30. How many models do you have?

- ○ < 10
- ○ 11-20
- ○ 21-30
- ○ >40
- ○ Other

(Please elaborate if you chosen other as your answer)

Number of models?

_____

31. How much time is spent using anatomical models in practical sessions?

- ○ < 1 hour
- ○ 1-2 hours
- ○ 3-4 hours
- ○ 5-6 hours
- ○ >6 hours

32. What types of models does the lab use?

- ☐ Skeletal system
- ☐ Nervous system
- ☐ Muscular system
- ☐ Circulatory system
- ☐ Neurological tissue including the brain
- ☐ Face
- ☐ Eye
- ☐ Ear
- ☐ Nose and sinuses
- ☐ Oral cavity
- ☐ Neck region
- ☐ Thoracic region/viscera
- ☐ Abdominal region/viscera
- ☐ Pelvic region/viscera
- ☐ Perineum
- ☐ Upper limb
- ☐ Lower limb
- ☐ Gluteal region
- ☐ Other

(If you have chosen other as your answer please elaborate)

Types of models? _____

33. Could you please give 3 reasons why your programme chose to use plastinated models _____

LIVING/SURFACE ANATOMY

34. Does your course offer living anatomy/surface anatomy where the physiotherapy students draw specific anatomical landmarks on each other?

- ☐ Yes
- ☐ No

35. If your answer was NO can you give a reason why this is the case? _____

36.Do the physiotherapy students use any other method(s) for learning living/surface anatomy? _____

TYPES OF LEARNING PROGRAMMES, EXAMINATIONS AND ADDITIONAL ONLINE LEARNING TOOLS

37.What type of approach to gross anatomy teaching is offered by your faculty?

- ☐ Systems
- ☐ Regional
- ☐ Both

38.What type(s) of learning programme(s) is/are offered in your course?
Please tick all options available in your programme

- ☐ Didactic learning
- ☐ Problem-based learning
- ☐ Vertical integration
- ☐ Integrated teaching
- ☐ Inter-professional education
- ☐ Peer group teaching
- ☐ Peer group tutoring
- ☐ Tutoring by teaching assistants or lecturers
- ☐ Team learning
- ☐ Case-based learning
- ☐ Other

(If you have chosen other as your answer please elaborate)

Learning programme?

_____

39.What type of additional online programmes are offered to students?

- ☐ Online learning management system
- ☐ Asynchronous online discussion forums
- ☐ E-book learning
- ☐ N/A
- ☐ Other

(If you have chosen other as your answer please elaborate)

What online programmes?

_____

40. What types of examinations are undertaken by the physiotherapy students during the course of the academic year?
Please tick all options that are available in your programme

- ☐ Multiple choice questions
- ☐ Untimed spot test
- ☐ Timed spot tests
- ☐ Short essay questions
- ☐ Viva voce examinations
- ☐ Other

(If you have chosen other as your answer please elaborate)

What type of exams?

_____

FINAL QUESTIONS

41. Do the physiotherapy students have the opportunity to evaluate the teaching by lecturers/teaching assistants that they are receiving?

- ○ Yes
- ○ No

How is this evaluation done?

_____

42. Is there a review process going on with regards to the gross anatomy course design for undergraduate physiotherapy students within your faculty presently?

- ○ Yes
- ○ No
- ○ Unsure

APPENDIX 8

- **INFORMED CONSENT FORM FOR FOCUS GROUP PARTICIPANTS**

CONSENT FORM FOR PARTICIPANT IN PHYSIOTHERAPY SERVICE DELIVERY SECTOR FOCUS GROUP

I …….. have read the information sheet and agree to take part in the focus group study conducted by Dorothy Shead.

I further agree to allow the information that I add to the focus group discussion to be used by the researcher, Dorothy Shead, in her study thesis.

However, I am fully aware that all information that I contribute to the focus group forum will be reported by the researcher in such a way as to maintain my anonymity.

I also agree to allow any information that I contribute to the discussion to be recorded and I am aware that such recorded material will be kept safely.

I understand that there are no monetary rewards for my participation.

I may, at any stage, without prejudice, withdraw my consent and participation in the study and this will not prejudice me in any way.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

Participant

Printed name:……..

Signed…….

Date……

Researcher: Printed name/
signed/date……

APPENDIX 9

- **INFORMATION FOR DISCUSSION GROUP PARTICIPANTS**

Dear Physiotherapy colleague,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

This study is being conducted with physiotherapists who are employed in different areas of service delivery in a number of categories.

The categories are:

- **Public sector physiotherapists working in a hospital**
- **Public sector physiotherapists working in a primary clinic**
- **Private physiotherapists working in a hospital**
- **Private physiotherapists treating outpatients**
- **Physiotherapy lecturers at Wits.**

It is limited to those members of such a group who practice in the Gauteng Province.
I would like to invite you to participate in a group discussion with other physiotherapists in your particular area of service delivery and would much appreciate your participation.

What is the purpose of the discussion groups?

The purpose of the discussion is to share views and suggestions relating to what physiotherapists in different areas of physiotherapy service delivery feel should be included in, excluded from, added to or modified in a gross anatomy course content for South African undergraduate physiotherapy students.

What is the significance of collecting such information?

Internationally there is increased clinical focus in curricula for physiotherapy students and new designs for anatomical courses are being reviewed. I am trying to establish where we are apropos global trends.

What would you be required to do?

You will be required to complete a short demographic questionnaire and fill in and sign a consent form before participating in the group .You are invited to offer opinions and suggestions on topics discussed in the group. Your participation in the meeting will take approximately one hour.

Important participation factors

The consent form will give me permission to tape record the discussion that you will take part in and to use any answers or information you provide within the group in my study. Your name will not be used in the reporting of results from the meeting. Your confidentiality will be guaranteed. Any information collected on the recording device will be kept safely. Participation is voluntary. If you want a summary of the research it will be supplied on request. There will be no monetary reward for participation due to possible research bias. Refreshments will be served after the meeting.

For any further information I can be contacted on cell phone number 082 491 7817 or Dorothy.shead@wits.ac.za or dots@icon.co.za

Kind regards
Dorothy Shead
MSc Physiotherapy, (WITS)

APPENDIX 10

- **INFORMATION FOR PHYSIOTHERAPY STUDENT PARTICIPANTS (STUDENT GROUP 1) TAKING PART IN THE GRLSS IN 2015**

Dear Physiotherapy student,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

An invitation

I would like to invite you to participate in a self- administered questionnaire that looks at the learning styles of students and would much appreciate your participation.

What is the significance of this part of the study?

Learning styles of students can be defined using a specific questionnaire. Teaching styles of lecturers can also be defined using a similar method. I am looking at the learning styles of undergraduate physiotherapy students taking gross anatomy course code 2033 and the teaching styles of their anatomy lecturers. I want to see whether there is any cohesion between the two groups. This may lead to a better understanding of gross anatomy and improved teaching methods for undergraduate physiotherapy students.

What would you be expected to do?

The gross anatomy co-ordinator for physiotherapy students has designated a date and time for the questionnaire to be distributed to you and your fellow students. The questionnaire will be handed to you on Friday 25 September 2015 in the physiotherapy department of the University of the Witwatersrand. You will be required to answer the 60 questions using the terms provided. The completed questionnaire will be collected on Monday 28 September 2015 in the physiotherapy department of the University of the Witwatersrand. Your class representative will hand you the questionnaire and will collect completed questionnaires. Your participation in the questionnaire will take approximately 30 minutes.

Important participation facts

Participation in this questionnaire is voluntary. If you submit a completed questionnaire to me it will indicate that you consent to the information you provide in the questionnaire being used in my study. Because your name will not be required or appear on the questionnaire your answers will be considered anonymous and your confidentiality will be guaranteed. If you want a summary of the research it will be provided on request.

My contact details

For more information I can be contacted on Dorothy.shead@wits.ac.za or on 082 491 7817.

Kind regards
Dorothy Shead
MSc Physiotherapy (WITS)

APPENDIX 11

- **INFORMATION FOR GROSS ANATOMY LECTURERS (GROUP1) TEACHING PHYSIOTHERAPY STUDENTS GROSS ANATOMY (CODE 2033) IN 2015**

Dear Colleague,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

An invitation

I would like to invite you to participate in a self-administered teaching style survey. Your participation would be much appreciated.

What is the significance of this part of the study?

Teaching styles of lecturers can be defined using a specific survey instrument and the learning styles of the students they teach can also be calculated. I am looking at teaching styles being used by lecturers who teach gross anatomy to undergraduate physiotherapy students at the University of the Witwatersrand and want to compare those results to the learning styles of their students. I want to know whether there is any cohesion between the two groups. It is also hoped that the study may have a bearing on the future gross anatomy curriculum and/or teaching methods offered to these physiotherapy students.

What would you be expected to do?

The gross anatomy co-ordinator for physiotherapy students has designated a date and time for the survey to be distributed to you and your colleagues. This will take place on Wednesday 23 September 2015. The survey will be delivered to you and the completed survey will be collected from you on Wednesday 30 September 2015 by the coordinator. Your participation in the questionnaire will take approximately 30 minutes.

Important participation facts

Participation in this survey is voluntary. If you submit a completed questionnaire to me it will indicate that you consent to the information you provide in the survey being used in my study. Because your name will not be required or appear on the survey your answers will be considered anonymous and your confidentiality will be guaranteed. If you want a summary of the research it will be provided on request.

My contact details

If you require further information please contact me at Dorothy.shead@wits.ac.za or on 082 491 7817.

Kind regards
Dorothy Shead
MSc Physiotherapy (WITS)

APPENDIX 12

- **INFORMATION FOR PHYSIOTHERAPY STUDENT PARTICIPANTS (STUDENT GROUP 2) TAKING PART IN THE GRLSS IN 2016**

Dear Physiotherapy student,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

An invitation

I would like to invite you to participate in a self- administered questionnaire that looks at the learning styles of students and would much appreciate your participation.

What is the significance of this part of the study?

Learning styles of students can be defined using a specific questionnaire. Teaching styles of lecturers can also be defined using a similar method. I am looking at the learning styles of undergraduate physiotherapy students taking gross anatomy course code 2033 and the teaching styles of their anatomy lecturers. I want to see whether there is any cohesion between the two groups. This may lead to a better understanding of gross anatomy and improved teaching methods for undergraduate physiotherapy students.

What would you be expected to do?

The gross anatomy co-ordinator for physiotherapy students has designated a date and time for the survey to be distributed to you and your fellow students. A questionnaire will be handed to you on 16 August 2016 in the physiotherapy department of the University of the Witwatersrand. You will be required to answer the 60 questions using the terms provided. The completed questionnaire will be collected on 16 August 2016 in the physiotherapy department of the University of the Witwatersrand. Your class representative will hand you the questionnaire and will collect completed questionnaires. Your participation in the questionnaire will take approximately 30 minutes.

Important participation facts

Participation in this survey is voluntary. If you submit a completed questionnaire to me it will indicate that you consent to the information you provide in the survey being used in my study. Because your name will not be required or appear on the survey your answers will be considered anonymous and your confidentiality will be guaranteed. If you want a summary of the research it will be provided on request.

My contact details

If you require further information please contact me at Dorothy.shead@wits.ac.za or on 082 491 7817.

Kind regards
Dorothy Shead
MSc Physiotherapy (WITS)

APPENDIX 13

- **INFORMATION FOR GROSS ANATOMY LECTURERS (GROUP 2) TEACHING UNDERGRADUATE PHYSIOTHERAPY STUDENTS GROSS ANATOMY (COURSE CODE 2033) IN 2016.**

Dear Colleague,

I, Dorothy Shead, am a PhD physiotherapy student, postgraduate physiotherapy mentor, teaching assistant in gross anatomy and gross anatomy tutor at the University of the Witwatersrand.

An invitation

I would like to invite you to participate in a self–administered teaching style survey. Your participation would be much appreciated.

What is the significance of this part of the study?

Teaching styles of lecturers can be defined using a specific survey instrument and the learning styles of the students they teach can also be calculated. I am looking at teaching styles being used by lecturers who teach gross anatomy to undergraduate physiotherapy students at the University of the Witwatersrand and want to compare those results to the learning styles of their students. I want to know whether there is any cohesion between the two groups. It is also hoped that the study may have a bearing on the future gross anatomy curriculum and/or teaching methods offered to these physiotherapy students.

What would you be expected to do?

The gross anatomy coordinator for physiotherapy students has designated a date and time for the survey to be distributed to you and your colleagues. This will take place on 10 August 2016. The survey will be delivered to you and the completed survey will be collected from you on 31 August 2016 by the coordinator. Your participation in the questionnaire will take approximately 30 minutes.

Important participation facts

Participation in this survey is voluntary. If you submit a completed questionnaire to me it will indicate that you consent to the information you provide in the survey being used in my study. Because your name will not be required or appear on the survey your answers will be considered anonymous and your confidentiality will be guaranteed. If you want a summary of the research it will be provided on request.

My contact details

If you require further information please contact me at Dorothy.shead@wits.ac.za or on 082 491 7817.

Kind regards
Dorothy Shead
MSc Physiotherapy (WITS)

APPENDIX 14

- **DEMOGRAPHIC QUESTIONNAIRE FOR PHYSIOTHERAPISTS IN SERVICE DELIVERY SECTORS**

I…….would be interested in taking part in a FG to discuss the gross anatomy curriculum content for South African undergraduate physiotherapy students.

What is your age? ☐years

What is your gender?
☐ female
☐ male

What is your educational level?
☐ BSc Physiotherapy
☐ MSc Physiotherapy
☐ PhD Physiotherapy
☐ Other (specify)
……

Do you have any postgraduate qualification(s) in any specific area/s of physiotherapy e.g. OMT1?
……

How long have you practiced as a physiotherapist
☐ 0-5 years
☐ 6-10 years
☐ 11-15 years
☐ 16-20 years
☐ 21-25 years
☐ over 25 years

I work in the following PT service delivery sector

Public sector PTs working in a hospital	☐
Public sector PTs working in a primary clinic	☐
Private PTs working in a hospital	☐
Private PTs treating out-patients	☐
PT lecturer at Wits	☐

Can you please elaborate as to an area(s) in which you mainly work or in which you have a special interest?

☐ Cardiopulmonary
☐ Orthopaedic
☐ Neuromuscular- skeletal
☐ Paediatrics
☐ Adult Neurology
☐ Community Health

If you are a PT lecturer please specify in which category of PT you teach?

☐ Cardiopulmonary
☐ Orthopaedic
☐ Neuromuscular- skeletal
☐ Paediatrics
☐ Adult Neurology
☐ Community Health

I practice in the…….area of Gauteng (e.g. Bedfordview)

Are you a member of a PT special interest group? ☐ Yes ☐ No

If yes please specify which group (s)……..…….

My email address for further correspondence is……

My cell phone number is……..

My hospital/clinic/practice phone number is……

Thank you for completing this questionnaire.

APPENDIX 15

- **SEMI-STRUCTURED QUESTIONNAIRE FOR FOCUS GROUPS**

Before we begin our session I would just like to say that the questions that we are going to discuss about being taught gross anatomy do not relate to any gross anatomy that you have been taught since you qualified as a physiotherapist.

Q1: Please tell me about the way that you were taught gross (not microanatomy/histology) anatomy when you were an undergraduate physiotherapy student?

Q2: How did you feel about learning anatomy in a team or group?

Ancillary questions

- If you experienced any tutoring how was it offered at the place where you studied your undergraduate physiotherapy anatomy course?
- Who were the tutors?

Q3 Can you tell me about the content of the anatomy course that you had as a student?

Ancillary question

- What would you have included/left out?

Q4: Using the clinical knowledge and experience that you have acquired what anatomical systems and regions would you suggest must be included in a gross anatomy course content for undergraduate physiotherapy students?

Ancillary Question

- Why are these systems/regions not negotiable for inclusion?
- Are there any regions/systems that you feel should be included but with less emphasis being placed on them than the ones already mentioned?
- What would you exclude completely?

Q5: How do you feel that the learning of anatomy could be made easier?

Ancillary questions

- How would this influence the students' learning of anatomy?
- Can you suggest any ways in which this might be done?

Q6: How did your gross anatomy education prepare you for clinical practice after you qualified as a physiotherapist?

Q7: How would you rate the importance of gross anatomical knowledge in the practice of your profession?

Q8: Perhaps you have other particular points or questions relating to the topics we have covered in the discussion so far? If so please feel free to share them with the group.

APPENDIX 16

- **RECORD OF FIELD NOTES FOR FOCUS GROUPS**

FOCUS GROUP 1

Participants all female... home language Afrikaans… three PTs from same practice so see how they relate to others and each other.
Lectures, Textbooks …materials used to teach anatomy Practical anatomy…Biomechanics… physio input
P1 trying to dominate discussion from start
First year anatomy…timing of anatomy Prosection- observation of cadavers…Dissection…pedagogies. 'James' the skeleton. Wet specimens
Modules…course divisions… Maturity of students
Physio driven anatomy course…. Mixed nature of course…too many students to make it only for physios
Intestine, musculoskeletal, muscles brain, peripheral nerves, lungs, spinal cord….content
First year subjects-physics, medical biology
Terminology…difficulty…new Latin names
Functional anatomy….anatomy application
Upper limb and lower limb
Timing of anatomy to physio muscle testing …Integration of clinical and anatomy
Vertical integration….importance
Length of physio course
Ethics and sensitization of seeing cadaver
Other forms of anatomy pedagogy? Watching surgeries, videos, skeleton
Inter-professional learning…OTs nurses, dentists
Staff type and amount of…not very knowledgeable.
Fourth year students know very little.
Economics dictates the length of the degree.
Learning from top to bottom. Glad P5 has entered the discussion. She seems quieter than the rest of the group...youngest…went to a different university than other 4.
PG- CPD and cost of it… Specialisation
Content…need to cover everything. Surface anatomy not covered enough???
Lots of laughter and interaction in group but at times immature…comments
Culture and religion and SA
IT technology use …computers…i-pads and Apps

FOCUS GROUP 2

Mostly young inexperienced physios…all female…have taught two as a TA in gross anatomy. Two of group from universities not in FG1
Quarters….division of course
Systems, brain, muscles
Looked at cadavers
Weekly tests
Practical exams
Division of content
Unfair questioning in tests…poor timing of tests
Love of anatomy and amazing lecturer.
Division of anatomy into small booklets…each section different textbook…helpful way to learn.
Dissections… bones
Types of exams…MCQs, spots
Effects of being promoted….oral tests…good to go through steps for exams
Stressful. Discipline of student
Anatomy included in strapping PG courses etc
Tables …muscles, innervation etc Biomechanics linked to anatomy
Drawing diagrams
Inappropriate topic for physio exam…mandible…really bad!
Learn medical terminology.
Not enough done on blood supply
Do anatomy 2nd year now in Comm Serv don't know muscles 100%.
Should integrate anatomy later in course.
3rd year did go back …such a difference when have some clinical knowledge
Bring in practicality …eg kicking a soccer ball.
Prac classes too big …couldn't hear lecturer
Basics in small textbooks …then filled in detail and clinical facts.
Too much self-learning from textbook…not being taught stuff.
Wednesday tutorial a waste of time.
General anger over the way in which some were taught anatomy…they feel let down by the system of teaching anatomy
Better if physios more involved with anatomy teaching.
Should separate physios and Ots
Also had nurses …speech therapists
Lose some histology.
Great to see the dissected bodies again later in course.
Dissection…cringed the first day. Helped to visualize
More tutors
Better preparation for dissection…have a video to show where to cut.
Prepare your own questions.
Two years of anatomy…anat+physology intertwined.
Better to learn say bladder with cadaver rather than computer…more realistic.
Histology ..not important …gross anatomy very important.
Long diatribe on type of anatomy week. Not really relevant. Blackboard okay.,,…didn't like
Dissection helped with depth of structures…3D …below muscles
Too much about organs…intestines… Lungs important

Bones and muscles should go together. Surface anatomy…draw on each other…privacy screens…boys did it. Religious Good to combine anatomy in physio classes …functions like rolling.

FOCUS GROUP 3

Group has 2 male participants. Also one participant is from university not represented in any group so far. So now have 5/8.
Senior practice physio takes charge of group to start
First year anatomy
2nd year anatomy
Practical on Friday
Group has 'loosened up'... less dominance by one member.
Staff…changed every semester…tutor groups different. Very disruptive.
Language
Dissection…loved it
More staff…too many students…not enough assistants
Timing…third year vertical integration
Content; abdomen and chest not covered…
On line Anat TV
Terminology
Dissection…it was bad…smell…handled…made to open the whole body
Emotional recollection of dissection….whole mood of group changed….more reflective and serious….mention of the 'hand' ….what makes the cadaver 'real'
Drawing .picasso…learn visually
Netter's Atlas
Slide show presentation
Spot test
Testing 1 or 2 smaller assessments
Written paper
Spot tests –timed or untimed…very stressful
Content; biomechanics
Vascular supply not covered enough
Veins not covered enough
GIT covered too much.
Goals per week
Field of interest
Back
Fascia- more important
All done PG studies
Histology and embryology…too much in overall course
In 4th year short courses on specific bits
Masters by coursework
CPD courses …need better regulation
Computers
Lung anatomy …did not spend a lot of time on that …did it with physio group
Groups Nurses, OTs, ourselves, podiatrists, dentists, pharmacy.
Taken fewer field notes…getting more used to asking questions and need less prompts to remind of what need to ask.

FOCUS GROUP 4

Pictures
practicals
Superficial muscles
Physio is muscles…Nice statement
Bones
Textbooks…Moore, Nettar's Atlas
2 hour lectures…not used …missed lectures
Systemic anatomy
2nd year anatomy
Self-taught
Dissection
All muscles and blood vessels
Big groups
Looked confused
Theory rushed
Supervision little
Anatomy course over 2 years
No specific textbooks but guide book
4 Quarters …UL, LL etc
In dissection group one person does everything
Didn't find dissection useful
Prosection
Wednesday practicals
Museum visits
Tests
Too much theory
Resources good
Gray's Anatomy
NOT ENOUGH STAFF
Physios have a specific personality type
See ring makes think of personal life of cadaver. Mood of group changed…thoughtful and sympathetic.
Face of cadaver covered…. Makes a difference….face makes human.
Emotional
Anatomy load …huge…makes one want to quit course
Spot tests too rushed…too much pressure.

FOCUS GROUP 5

Dissection- lectures- tuts- 1ce per week
No computers- yes computers
Museum
Textbooks…objective book
Staff Poor ratio
Group 6-8 for dissection
Plastinated
Self study
Diss 4x week….2 per cadaver. 15mins, 20mins- 30 mins of what was to be covered.
I table doc /4 tables.
Lectures- dissection manual- prac books assessed every 2 weeks- marked for dissection skills.
Lectures- long tedious – TIRING
Prac Friday 1ce/week
HATED dissection SMELL.
Prosection- 10 in group – 1 cadaver.
- like a spot
At 1 university PT students had separate dissection- 5/6 per cadaver. No –dissection- observation LEARN Test and exams
Loved dissection –dress code
Had amazing lecturers Content: Took bones home. Not allowed to take home bone box
Anatomy 1st year Student Drs given more attention to detail Some had good feeling about dissection Staff number –quality
GROUPS –SIZE-MIXTURE Drawings prac books LEARNING BY DOING- learning techniques TIME
Content-TOO MUCH. Exam-recall. HISTOLOGY –TOO MUCH Other varsity group Med, nursing OT
Surface anatomy important

APPENDIX 17

- **DEMOGRAPHIC QUESTIONNAIRE FOR PHYSIOTHERAPY STUDENT GROUP 1(2015) TAKING PART IN GRLSS**

Please complete the following questions:

1. How old are you? ☐ years
2. What is your gender? ☐ 1. Male ☐ 2. Female
3. Which High School did you matriculate from?
   High School _____ Province _____
4. Have you had to repeat second year gross anatomy? ☐ Yes ☐ No
5. Complete the following table based on marks obtained in your previous year of study and 2015 up until now.

Year of study	**Subject**	**Mark at the end of 2014 (symbol and/or %)**
First year	Physics	
		Mark so far in 2015 (symbol and/or %)
Second year	Anatomy	

6. What artistic pursuits do you have?
   ☐1. Dance
   ☐2. Painting
   ☐3. Acting
   ☐4. Singing
   ☐5. Writing prose or poetry
   ☐6. Play a musical instrument
   ☐7. Other (specify) _____

APPENDIX 18

- **DEMOGRAPHIC QUESTIONNAIRE FOR PHYSIOTHERAPY STUDENT GROUP 2 (2016) TAKING PART IN THE GRLSS**

Please complete the following questions:

1. How old are you? ☐ years
2. What is your gender? ☐ 1. Male ☐ 2. Female
3. Which High School did you matriculate from?
   High School _____ Province _____
4. Have you had to repeat second year gross anatomy? ☐ Yes ☐ No
5. Complete the following table based on marks obtained in your previous year of study and 2015 up until now.

Year of study	**Subject**	**Mark at the end of 2015 (symbol and/or %)**
First year	Physics	
		Mark so far in 2016 (symbol and/or %)
Second year	Anatomy	

6. What artistic pursuits do you have?
   ☐1. Dance
   ☐2. Painting
   ☐3. Acting
   ☐4. Singing
   ☐5. Writing prose or poetry
   ☐6. Play a musical instrument
   ☐7. Other (specify) _____

APPENDIX 19

- **DEMOGRAPHIC QUESTIONNAIRE FOR LECTURER GROUPS 1 2015) AND 2 (2016)**

Please complete the following questions:

1. How old are you? ☐ years
2. What is your gender? ☐ 1. Male ☐ 2. Female
3. What is your level of education?

   _____

4. How many years of experience do you have in your current profession? ☐ years

5. Describe your teaching philosophy by completing the following sentence:
   I believe that teaching is

   _____
   _____
   _____
   _____
   _____
   _____
   _____

APPENDIX 20

- **TURN-IT-IN REPORT**

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Gross Anatomy Education for South African Undergraduate Physiotherapy Students. Dorothy A. Shead, 1,2* Ronel Roos, 1 Benita Olivier, 1 Amadi O. Ihunwo2 1 Department of Physiotherapy, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa 2 The School of Anatomical Sciences, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa Correspondence to: ? Dorothy Shead, Department of Physiotherapy, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, Johannesburg 2193, South Africa. ? Telephone: +2711 717 3702 ? Fax number: +2711 717 3719 ? E-mail: Dorothy.shead@wits.ac.za / dots@icon.co.za Physiotherapy students in South Africa learn anatomy as a basis for clinical practice. There is paucity of information about gross anatomy education for this student body. A 42-question peer- reviewed survey was distributed to physiotherapy gross anatomy course co-ordinators in eight Health Science Faculties in South Africa. Seven co-ordinators from six (75%) of the universities responded. Two respondents' data from the same university were pooled. Staff qualifications varied widely per faculty. Staff experience was from five years to more than eleven years. Results showed high to average staff to student ratios. Direct anatomy teaching duration was 12. 25 (SD 5. 19) weeks per semester and total number of weeks in courses per year was 27. 60 (SD 5. 73) varying widely between institutions. Anatomy hours per year spanned from 100 to 308. Lectures ranged from one to two hours to over six hours per week. Practical sessions lasted from one to two hours to five to six hours per week. Dissection, prosection, plastinated models, surface anatomy and e- learning were found across faculties. Ancillary modalities such as vertical integration and inter-professional learning were in use. All faculties had multiple-choice questions, spot tests, and viva-voce examinations. All six had short questions and one had additional long questions assessment. Students evaluated teaching performance in five faculties. Four programmes were under review. Our findings highlighted disparity between programmes and also identified the need for specific guidelines to develop a unified South African gross anatomy course for physiotherapy students. Key Words Anatomy, Education, Physiotherapy, Undergraduate INTRODUCTION Throughout history medical education has had a strong anatomical component (Papa and Vaccarezza, 2013). The teaching of anatomy in South Africa began in 1911 at the South African College, later called the University of Cape Town (Correia et al., 2013). In 1919 an anatomy department was started at the South African School of Mines and Technology that later became the University of the Witwatersrand (WITS) (Correia et al., 2013). The Department of Physiotherapy at WITS has the oldest physiotherapy programme in South Africa: a three year diploma in physiotherapy was offered from 1938 but in 1943 the four year degree was established under the leadership of Professor Raymond Dart (Myezwa et al., 2013) an anatomy professor and Dean of the Medical School from 1925-1943 (Tobias, 2007). Thereafter, anatomy became consolidated in the undergraduate physiotherapy course. The progressive introduction of undergraduate physiotherapy degrees at other universities increased the need for anatomy teaching for these students. Aspects to consider when developing anatomy teaching are the role of said professionals, course content

and type of pedagogy (Kielbard, 1989). Physiotherapy is a clinical profession where professionals aim to maximise clients' ability to move and function when clients have been affected by ageing, physical injury, diseases and disorders (World Confederation for Physical Therapy, 2016). Gross anatomy knowledge is thus vital for these professionals to enable them to evaluate normal movement effectively and identify abnormality. Gross anatomy curriculum for undergraduate physiotherapy students should thus be clinically relevant to physiotherapy practice (Johnson et al., 2012; Moxham et al., 2014). Many types of anatomy pedagogies are used to improve the anatomical learning experience (Sugand et al., 2010). Pedagogies used in undergraduate physiotherapy education include: dissection (Pawlina and Lachman, 2004; Kramer et al., 2008;Torres et al., 2014); prosection (Topp, 2004; Patel and Moxham, 2008) inter-professional education (IPE) (Shields et al., 2015; Sytsma et al., 2015), online discussion forums (Green et al., 2014), blended learning (Green and Whitburn, 2016), multi-modal models (Nicholson et al., 2016) and peer teaching (Machado de Oliviera et al., 2015; Sytsma et al., 2015). Benefits of pedagogies chosen are diverse. Youdas et al (2013) reported that dissection enhanced professional behaviours in first year doctor of physical therapy students. Inter-professional education models that include team collaboration have resulted in improved academic performance (Hultt, et al., 2015; Machado de Oliveira et al., 2015; Nicholson et al., 2016); enhanced clinical problem solving (Sytsma et al., 2015); better understanding of the roles of other healthcare providers and increased interest in and ability for teamwork between professional groups (Shields et al., 2015; Livingston et al., 2014). Asynchronous online discussion forums demonstrated improved student learning outcomes (Green et al., 2014) and blended learning methods proved beneficial when students retained face-to-face practical sessions (Green and Whitburn, 2106). A paucity of literature reporting on gross anatomy education, specifically for the undergraduate physiotherapy students in South Africa, is available. The aim of the study was thus to describe the current gross anatomy content and teaching methods used during gross anatomy education programmes for undergraduate physiotherapy students at health sciences faculties in South Africa. METHODS A cross-sectional, observational, survey-based study was undertaken. The sampling was specific and limited to gross anatomy course co-ordinators for undergraduate physiotherapy students at South African health science faculties during the 2016 academic year. Health science faculties were included in the study if they offered a physiotherapy programme. The health science faculties that fulfilled the inclusion criteria were Sefako Makgatho University, Stellenbosch University, University of Cape Town, University of the Free State, University of Kwa Zulu Natal, University of Pretoria, University of the Western Cape and WITS. Ethical clearance for the study was given by the Human Research Ethics Committee (Non-Medical) of the University of the Witwatersrand in Johannesburg, South Africa. The Anatomical Society of Southern Africa (ASSA) granted permission for data collection in the relevant anatomy departments. Each Head of School or Head of Department of Anatomy at the identified health science faculties gave permission for their gross anatomy course coordinators to be contacted. Participation in the study was voluntary, anonymous and no incentives were offered to participants. Survey structure and outcome variables The survey for this study was adapted from an existing open access instrument used to measure how physical therapy schools in the United States of America teach gross anatomy (Reimer et al., 2013). It was altered to suit the South African gross anatomy health sciences educational system both in content and in terminology. The survey was peer-reviewed prior to circulation to study participants. This process was undertaken using the 2015 gross anatomy course co-ordinator for undergraduate physiotherapy students at the University of the Witwatersrand. This co-ordinator did not take part in the 2016 survey. The final survey, which was directed to anatomy course coordinators, contained 42 questions that assessed the following information: demographic profile of gross anatomy teaching staff; number of students and staff to student ratios; time spent teaching gross anatomy to undergraduate physiotherapy students; the pedagogies in use when teaching gross anatomy; laboratory information; curriculum content, teaching evaluation by the undergraduate physiotherapy students and whether there was a review process being undertaken within the gross anatomy programme of that faculty. The validated electronic gross anatomy survey was sent out to the nine eligible recipients from the eight universities on 11 March 2016. An online platform, namely REDCap (Research Electronic Data Capture) hosted at WITS, was used (Harris et al., 2009) to distribute the questionnaire to participants. Participants had six week to respond to the survey. Three reminders were sent to potential study participants. Data analysis Descriptive data analysis was done using IBM SPSS 24 statistical package (Version 24.0 Armonk, NY: IBM Corp, 2016). Findings are presented as means (± standard deviation) and frequencies and percentage using tables or figures. Missing data were not replaced and therefore not included in the analysis process. RESULTS Out of the nine gross anatomy course co-ordinators approached to participate seven (77.8%), from six of the eight universities (75%), responded to the study invitation. Results from the two co-ordinators from the same university have been pooled to give a comprehensive overall result for that health science faculty. Table 1 summarises results relating to the demographic profile of teaching staff. Most programmes had over six staff members (n=5, 83.3%). Reported academic staff experience fell into two distinct categories. The range of staffs' level of education included those with PhDs (n=5, 83.3%), master's degrees (n=6, 100.0%), honours degrees (n=3, 50.0%) and bachelor's degrees (n=2, 33.4%). No gross anatomy course's staff compliment had the same combination of higher qualifications as another. Total number of staff by gender, in all programmes (100.0%,), included twelve males and twenty-four females. Number of students and staff to student ratio The physiotherapy student compliment per faculty ranged between fifty-one and seventy students (n=5, 83.5%), thirty-one and fifty students (n=1,16.7%) and seventy-one and ninety students (n=1, 16.7%). Ten or less students were repeating the course for a second time (n=6,100%). Staff to student ratio was equally high (n=3, 50.0%) or average (n=3, 50.0%)(Table 1). Time spent in teaching the gross anatomy course Table 2 summarises results pertaining to the number of gross anatomy semesters per year, number of weeks in a semester (mean of 12.25 ± 5.19 for n= 6,100%) and the total number of weeks spent in anatomy per year (mean of 27.60 ± 5.73 for n= 5, 83.4%). This table also records the direct contact hours per week spent by physiotherapy students in lectures and practical sessions as well as the allocation of 'OPEN LAB' time. Calculable total gross anatomy direct contact hours per year were one hundred (n=1,16.7%), under two hundred hours (n=2, 33.4%), two hundred and fifty two (n=1,16.7%) and three hundred and eight (n=1,16.7%). Laboratory information Cadavers available for dissection ranged between zero and twenty-one with a mean of seven (6.43, SD ± 7.30). Recorded numbers of physiotherapy students assigned per cadaver were between four to six students in two faculties (33.4%) and ten to twelve in three faculties (50.0%) . Figure 1 illustrates the various other student disciplines using the same gross anatomy laboratory as the physiotherapy students. Teaching pedagogies The distribution of teaching methods used in the gross anatomy programmes is shown in Table 3. Pedagogies are found alone or in various combinations across the programmes. The 'Other' category, responses included that "practical's are held using wet specimens" and "student may visit the anatomy museum any time during office hours". Physiotherapy students were allocated a number of direct contact hours per week for dissection alone. These were zero to two hours (n=1, 16.7%), three to four hours (n=2,

33.4%) or five to six hours (n=1, 16.7%). Two faculties (33.4%) allowed students to dissect later in their curriculum. "They do a dissection module in the second semester" said one respondent and another said "The department is open for any student who wishes to dissect as part of a research project". The amount of time allocated per programme for the use of prosected cadavers included less than one hour (n=2, 33.4%) and one to two hours (n=3, 50.0%). Two faculties (33.4%) had separate smaller dissections from cadavers while others offered between one to five (n=2, 33.4%), six to ten (n=1, 16.7%) or more than eleven (n=1, 16.7%) full body prosections for learning purposes. Three (50.0 %) of the six faculties did not have a computer based learning programme. Giving reasons for this one respondent said "There are not enough computers available in the faculty for all the students to use it at once." and another commented that "The University unfortunately have not approved the budget to buy a computer based programme, such as Visible Body or Primal Pictures for students to use". The types of computer programmes used in two of the other three faculties included Acklands, Real Anatomy. Computer programmes were used because "it gives the students the opportunity to look at structures in 3D," "it was the ability to view the body in a similar manner as if dissecting it."..."Also the ability of students to test their own knowledge."...."The ability to use the programme as an adjunct to work done in the dissection hall," and for "revision, assignments and assessment." The length of time that computer-based programmes had been in situ was less than five years (n=1, 16.7%) and five years (n= 1, 16.7%). Of the faculties using anatomical models or plastinated specimens three reported having more than forty models (50.0%), one had between twenty-one and thirty models (16.7%) and one gave no numerical information (16.7%). The time spent using these learning tools in practical sessions, was reported as less than one hour (n=3, 50.0%) and one to two hours (n=2, 33.4%). Figure 2 illustrates the available range of anatomical models and plastinated specimens and shows an even distribution over the systems/regions of the human body. In the 'Other' category it was noted by respondents that there were few anatomical models or plastinated specimens of the perineum and the larynx was added to the list. Although the survey questions were on the use of plastinated specimens it appears that some answers pertained to (plastic) anatomical models instead. Table 4 lists reasons given by respondents for the use of these educational tools There were five positive responses (83.5%) and one negative response (16.7%) to the question of whether physiotherapy students had living/ surface anatomy sessions. Reasons for not offering this pedagogy or limitations in the offering of it and suggestions for alternative methods of addressing the teaching of living/surface anatomy are presented in Table 4. Approaches to learning and assessment The approach to learning gross anatomy included: regional (n=3, 50. 0%), systems (n=1, 16.7%) and mixed methods (n= 2, 33.4%). There was a varied distribution of learning programmes among the faculties. The choices that were given are summarised in Table 5 together with the various combinations of learning programmes found. Three faculties (50.0%) used online learning management systems. Only one (16.7%) named the programme used (Moodle) and one faculty used online E-book learning (16.7%). All programmes used multiple-choice questions (MCQs), short essay questions and timed spot tests (n=6, 100%). One faculty (16.7%) also gave the students one long essay question per test/exam and three programmes (50.0%) held viva voce examinations. With regards to teaching evaluation of staff by physiotherapy students one faculty (16.7%) did not have a process in place, at two faculties (33.4%) an online Quality Performance Accreditation (QPA) questionnaire was administered and two faculties (33.4%) used student evaluation forms. Another respondent (16.7%) remarked that questionnaires were used. To the question: Is there an on-going gross anatomy programme review process in your faculty? Four respondents (66.7%) replied yes, one (16.7%) was unsure and one (16.7%) said no. DISCUSSION This study gathered much useful information about the curricula and pedagogies used in the gross anatomy teaching of undergraduate physiotherapy students in South Africa. It highlighted areas of disparity between the gross anatomy programmes offered nationally. Teaching staff to student ratios in South African gross anatomy programmes for undergraduate physiotherapy students was obtained in order to compare them to similar international data as to establish whether international trends towards a decrease in staff to student ratios applied in the South African scenario. In their narrative review, Bergman et al (2011) reported that Pryde and Black (2005) had found that staff to medical student ratios in Scotland had decreased from 1:20 in 1983/1984 to 1:58 in 2003/2004. This identified a general trend towards less staff to teach more students. It was stated by Kramer et al (2008) that suitable staff to medical student ratios across the African continent were high (between 1:15 and 1:35 in Egypt, 1:15 to over 1:35 in Nigeria, Uganda and South Africa, 1:25 in Malawi and Mozambique and 1:30 in Zambia) compared to those in the United Kingdom of 8:19 in dissection classes and 1:10 in demonstration classes as reported by Heylings (2002). Ratios recorded in three of the faculties surveyed in this study appear high compared to both of the afore-mentioned studies but three are similar to those ratios recorded in the Kramer et al (2008) study. However, the fact that the studies are approximately a decade old, they address a medical student population and one is Scottish has to be factored in when considering their relevance to a 2016 South African physiotherapy student population. A recent study by Green and Whitburn (2016) has thrown new light on this matter by reporting staff to physiotherapy student ratios during anatomy practical sessions of approximately 1:25. The ratios recorded in our study fall evenly on either side of this benchmark. This survey showed that the staff teaching the anatomy course generally had doctorate, masters, honours or bachelor degrees. This breakdown of personnel by level of education teaching anatomy to South African physiotherapy students mirrors the results reported by Kramer et al (2008). In our study average years of experience of staff was found to be five years in two faculties and over eleven years in four faculties respectively. The ratio of male to female staff members reported was indicative of a tendency for twice as many females than males to be in this line of work. The direct contact hours per week that students experienced either in lectures or in the dissection laboratory (practical work) were seen to vary across the country. There seemed to be a preference for programmes offering approximately seven direct contact hours per week but three programmes did not conform to this pattern. Two offered more overall direct contact hours and one less contact hours. The total gross anatomy learning time, including direct contact hours, for a programme could also incorporate time spent in computer- based learning, open lab time, and other forms of time utilisation. The fact that the didactic (lecture) learning model is often seen as old fashioned and too passive may predispose to a more mixed methods 'blended' approach to the learning of anatomy particularly with the use of computer technology (Estai and Bunt, 2016). However, beneficial learning outcomes from this type of methodology may require the maintenance of personal interaction in practical sessions and rely on students and staff dealing with a perceived increased workload (Green and Whitburn, 2016). All respondents said that the physiotherapy students shared the dissection laboratory with other diverse health sciences student groups. There is literature available that describes gross anatomy pedagogical interventions involving different and diverse groups of students in the laboratory setting namely: medical and physiotherapy students involved in teamwork and clinical problem solving in association with dissection (Systma et al, 2015), medical and doctor of physical therapy students using quick response codes on cadaveric specimens (Traser et al, 2015) and medical, midwifery, nursing,

physicians assistant, physiotherapy and occupational therapy students dissecting in inter-professional groups (Fernandes et al, 2015). Hence, it was established that in line with international trends inter-professional student interaction occurred during laboratory gross anatomy programmes in this country. Four of the six respondents (67%) reported that their gross anatomy programmes offered dissection to the students. Heylings (2002) found that in the United Kingdom (UK) and Ireland dissection was still being used in 76% of anatomy programmes. Kerby et al (2011) in the UK and Bekele et al (2011) in Germany and Ethiopia reported that undergraduate medical students viewed dissection to be a relevant part of their course. Perhaps this attests to the findings of Patel and Moxham (2008) and Torres et al (2014) who found that dissection was the preferred gross anatomy teaching methodology. Gangata et al (2010) reported that 80% of cadavers used for dissection in South Africa were donated. They also stated that in many African countries the lack of awareness of the possibility of donating one's body together with religious and cultural burial traditions resulted in a low number of cadavers being bequeathed. The shortage of cadaveric material in certain South African regions may perhaps be explained by this phenomenon and be related to the fact that two of the surveyed programmes reported a high ratio of 10-12 students per cadaver. Craig et al. (2010) found, in a survey of anatomy education in twenty one medical schools in Australia and New Zealand, that only three offered dissection as a whole body experience. These authors reported that prosection was used predominantly for gross anatomy education. Our findings indicate that five of the six gross anatomy programmes offered prosection or prosected cadaveric material. Apart from one programme that only used prosection this teaching method was used in various combinations with other anatomy pedagogies. Three of the courses offered prosection in combination with dissection. However, the amount of time allocated to gross anatomy practical sessions, using prosected cadavers, or smaller prosected specimens was found to be limited. Computer-based anatomy education was used in half of the faculties in South Africa. The comment by one respondent that this technology can give the student a 3D perspective of anatomical structures is on a par with the feedback given by Silén et al (2008) regarding the learning of such complex structures. Lewis et al (2014) also stated that the use of tablet computers, with certain anatomy applications, not only give the student a 3D perspective of structures but allow the student to manipulate such structures. Biasutto et al (2006), in a comparison of cadaver dissection to computer-based learning, concluded that neither methodology in isolation was the optimal choice and that a combination of the two pedagogies offers the best option. However, they pointed out that computer technology does not replace the "hands on" value of interacting with human tissues that comes with dissection. All surveyed universities in our study are located within urban areas of South Africa. Some have not been established for as long as others and/or are not as financially equipped. The resultant problem with budgetary constraints led two respondents to point out that their faculties did not use computer-based learning. One stated that there were not enough computers for all the students to use at the same time and another said the university had not approved funding for a computer-based programme. Azu et al (2012) reported that 75% of surveyed medical and anatomy students found plastinated specimens to be an extremely useful tool for anatomy learning. It was stated by Craig et al (2010) that plastinated specimens were used by less than half of the programmes identified in their Australian and New Zealand study. One of the respondents in this South African survey specified that plastinated specimens were used to compensate for a shortage of cadaveric material. Time constraints that have arisen in gross anatomy education, as reported by Papa and Vaccarezza (2013), were alluded to by one respondent giving reasons for the use of anatomical models and plastinated specimens and who said "There is not enough time allocated to anatomy in the physiotherapy programme to allow for dissection." The same respondent noted that when structures are small, unclear or unavailable on a cadaveric dissection, it might be preferable to utilise larger scale models as an alternative to dissection or if the mobility of the structure needs to be tested the use a model may be a good alternative. Living anatomy and/or surface anatomy was offered in 83.5% of the programmes. Reasons for limitations were given and ranged from religious or cultural concerns to large class structure and resultant time constraints for this form of anatomy. Suggestions made by respondents for their students included the use of palpation of structures either on the skin of a cadaver, on a willing class volunteer or on themselves. Perhaps "muscle cut out and paste exercises", as described by Gangata, (2008), could be considered to improve learning outcomes in an interesting and enjoyable way and help address the limitations. Furthermore, Nicholson et al (2016) incorporated four multi-modal learning strategies into an anatomy workshop for health sciences, physiotherapy, occupational therapy, exercise physiology and exercise and sport's science students. Perhaps this type of successful intervention could be applied to the South African programmes. Globally, students learn gross anatomy by a systems-based, regional-based or a mixed approach incorporating both of the other two methods. Stabile (2015) reports that the systemic approach may not be best suited to use with dissection and may be problematic for precise identification of structures and the interrelationship between them. She recommends that the mixed approach is probably preferable. In this study two faculties were found to use the mixed approach, three used the regional approach and one used the systemic approach. Case-based learning with vertical integration seeks to help address the need for a link between anatomy and future professional practice (Parmar and Rathinam, 2011). This study only found one programme where both these factors were incorporated. Three studies did have case-based learning in their programmes and two had vertical integration within their fabric. Peer group teaching was used in 67%% of the gross anatomy programmes. Inter-professional learning occurred in two programmes. One of these specifically stated that physiotherapy and occupational therapy students worked together. This form of teaching methodology has had beneficial results on student examination outcomes in inter-professional groups as reported by Machado de Oliviera et al (2015) in Brazil. This survey identified that most evaluation of the effectiveness of gross anatomy programmes was done by examinations that followed the same basic format with only one faculty including the use of a longer essay question in each of their examinations. All spot tests were done using timed formats. In this regard Zhang et al, (2013) reported that, for entry-level doctor of physical therapy students, the comparison of the results of timed and untimed practical spot tests showed no significant difference. The evaluation of anatomy teaching by the students was generally undertaken using a questionnaire. Five faculties (83.5%) offer this way of evaluating staff and therefore it seems that the majority of faculties take into consideration student feedback regarding their satisfaction with the teaching offered to them. It appears that four gross anatomy programmes are undergoing a review process presently. One respondent was unsure about whether their programme was being revised and one has no review process occurring. The results of this study point to the fact that there are differences in gross anatomy curricular inclusions, staff/student ratio quotients, pedagogies used in the teaching of the subject and ancillary additions to programmes for undergraduate physiotherapy students within health sciences faculties in South Africa. Heylings (2002) reported on a similar situation occurring in the UK and Craig et al (2010) found variations in programmes based on individual institutional discretion in a review of anatomy education in Australia and New Zealand. The two previously mentioned studies reported that there was no generalised state controlled national curriculum guide for anatomy education in

those countries which could explain the diversity of course curricula. Both of these studies also queried whether the depth and scope of such variations in anatomy programmes impacted on the quality of the outcomes achieved. This study found a similar situation where no national guidelines are in place and hence there is a resultant lack of conformity between anatomy programmes in South Africa. LIMITATIONS The survey response contained six of the possible eight participants that fulfilled the inclusion criteria and this was a limitation especially considering that the sample size was small. The other factor that could have had a bearing on the accuracy of the results was that two respondents came from the same university and there was some variation in their reported data. FUTURE DIRECTIONS A future study of this nature should look at the breakdown of the staff teaching gross anatomy into academic (lecturers) and clinical (physiotherapists) categories to analyse the effectiveness of having direct input from both of these professions in making the course more clinically orientated along with international guidelines. Studies should be engaged to assess undergraduate physiotherapy students' academic outcomes and the faculty throughput should also be recorded to assess the effectiveness of any gross anatomy programme. CONCLUSIONS In summary, this study addresses the need for an up-to-date report on the types of pedagogies and curricula followed in gross anatomy programmes in South Africa. It is clear that dissection is still widely used but that in certain areas there is a shortage of cadavers and as a result plastinated specimens and anatomical models are used more extensively in gross anatomy programmes. Computer-based learning is used but this is limited in some areas due to financial considerations. South African gross anatomy programmes contain the mainstream types of learning pedagogies albeit in different variations within each programme. New ideas such as inter-professional learning and e-book learning are being introduced in a few programmes but most are lagging behind in this regard. It is hard to assess accurately the level of clinical relevance incorporated in the South African programmes. Two programmes did include case-based learning but it is possible that elements of clinical integration could be present in other methodologies. It can be seen from these data that specific guidelines are needed for the development of a unified country specific gross anatomy programmes for physiotherapy students. Overall the survey results contribute to the body of knowledge on gross anatomy education globally. NOTES ON CONTRIBUTORS DOROTHY A. SHEAD. B.Sc Physiotherapy, MSc Physiotherapy, PhD candidate is a teaching assistant and tutor teaching morphological anatomy to undergraduate physiotherapy students in the School of Anatomical Sciences at the University of the Witwatersrand. RONEL ROOS PhD is a senior lecturer in cardiopulmonary physiotherapy at the University of the Witwatersrand BENITA OLIVIER PhD is an associate professor in musculoskeletal physiotherapy at the University of the Witwatersrand. AMADI O. IHUNWO PhD is an associate professor and Head, Morphological Anatomy Division, in the School of Anatomical Sciences at the University of the Witwatersrand. Table 1. Staff profile in Health Sciences Faculties in South Africa Health Science respon dent Total number of staff including lecturers TAs and tutors (Frequency and %) Average years of experience of teaching staff (Frequency and %) Ratio of male to female teaching staff (Frequency and %) Staff to UG PT student ratio (range) (Frequency and %) PhD Range of level of education of staff teaching Masters gross anatomy to UG PT students Honours Bachelor Other Frequencies and (%) of occurrence of range of level of staff education Cumulative % of occurrence of range of level of staff education 1 6-10 (n=3, 50.0%) >11 (n=4, 66.8%) 1:2 (n=1,16.7%) 2:16 (n=1, 16.7%) 1 1 1 Senior professor n=1(16.7%) 16.7% 2 6-10 (n=3, 50.1%) >11 (n=4, 66.8%) 1:3 (n =1,16.7%) 1:3 (n =1,16.7%) 1 1 1 1 n=1 (33.4%) 33.4% 3 11-15 (n=2, 33.4%) 5 (n=2,33.4%) 6:6 (n=1,16.7%) 1:35 (n=1,16.7%) 1 1 1 n= 1 (16.7%) 50.0% 4 0-5 (n=2, 33.4%) >11 (n=4,66.8%) 2:11 (n=1,16.7%) 1:39 (n=1,16.7%) 1 1 n=1 (16.7%) 66.7% 5 11-15 (n=2, 33.4%) 2:1 (n=1,16.7%) 1:5 (n=1,16.7%) 1 1 n=1 (16.7%) 83.5% 6 0-5 (n=2, 33.4%) 5 (n=2,33.4%) 0:1 (n=1,16.7%) 1:30 (n=1,16.7%) 1 1 n=1 (16.7%) 100.0% Table 2. Summary of distribution of total time spent on a gross anatomy programme and the theoretical and practical aspects of such a programme Number of semesters/year in gross anatomy course (frequency and % of semesters/course) Number of weeks/semester in gross anatomy course (frequency and %) Total number of weeks in gross anatomy course/year (frequency and %) Frequency and % of time spent in lectures/ gross anatomy course (hours/week) Frequency and % of time spent in practical sessions/gross anatomy course (hours/week) Frequency and % of "OPEN LAB" time/ gross anatomy course (hours/week) 2 (n=3, 50.0%) 10 (n=1, 16.7%) 14 (n=1, 16.7%) 18 (n=2, 33.4%) 20 (n=1, 16.7%) 28 (n= 2, 33.4%) 36 (n=1, 16.7%) 3-4 (n=3, 50, 0%) 3-4 (n=3, 50, 0%) 3-4 (n= 3, 50,0%) 1-2 (n=2, 33 .4%) 3-4 (n= 2, 33.4%) 3-4 (n= 2, 33.4%) 5- 6 (n=1, 16.7%) 1-2 (n=3, 50.0%) 4 (n=1, 16.7%) 6.5 (n=1, 16.7%) 26 (n=1,16.7%) 1-2 (n=1, 16.7%) 5-6 (n= 2,33, 4%) >6 (n=2, 33, 4%) 1 (n=1,16.7%) 28 (n= 2, 33.4%) 5-6 (n=1, 16.7%) 5-6 (n=2, 33, 4%) >6 (n=2, 33.4%) 7 (n=1, 16.7%)> 6 (n=1,16.7%) 1-2 (n= 2, 33.4%) Table 3. Summary of the distribution of teaching pedagogies Types of teaching pedagogies/gross anatomy course (Frequency and %) Combinations of pedagogies/gross anatomy course (Frequency and %) Dissection (n=4, 66.7%) Prosection (n=5, 83.5%) Computer – based learning (CBL) (n=3, 50.0%) Anatomical models/plastinated specimens (AM/PS) (n=5, 83.5%) Other (n=2, 33.4%) Prosection (n=1, 16.7 %) Dissection, AM/PS and Other (n=1, 16.7%) Prosection, AM/PS and Other (n=1, 16.7%) Dissection, Prosection, CBL and PS/AM (n=3, 50.0%) Table 4. Comments on the use of anatomical models and plastinated specimens and the limited offering of living/surface anatomy for physiotherapy students Respondent Comments on reasons for the use of plastinated specimens/anatomical models 1 "Due " Due to shortage of cadaveric material." 2 " They are also used as an adjunct method to add on to the others that are used. "..." They also assist if specimens showing the required structure are not available." 3 '" We have a big collection of models showing the different structures. "..." We do not have enough cadavers so that students in other courses, apart from medicine, can dissect."..." There is not enough time allocated to anatomy in the physiotherapy programme to allow for dissection." 6 " 1. "" Easy to demonstrate on larger scale models, especially smaller structures like the eye, ear and larynx. "..."It aids with demonstrating areas that are difficult to dissect or structures that aren't always clear on cadavers or specimens, or not always following the ideal anatomy as described in that books can... can be demonstrated."...."Some models aid in demonstrating the mechanical workings of certain structures by having movable parts." textb Comments on reasons for not offering or limitations in the offering of living/surface anatomy 2 "P "Probably our facilities do not allow at the moment. "..."Secondly physiotherapy attends with occ therapy mostly making it a big class hence such kind of a I of a lesson would consume quite some time." "Depending on presence of a willing volunteer, the student can be used to demonstrate." ..." I normally ask s ask students to palpate on themselves when it is possible." 3 " "Dif "Differences in students' cultural and religious beliefs." Suggestions for alternative methods of addressing the teaching of living/surface anatomy that were outlined by the respondents 2 "Th "The use of Lodox scans of each cadaver."... powerpoint with images showing the relevant structures."... 4 "Photographs showing the surface anatomy/living surface anatomy is only done during the clinical years. " 6 "We also require them to palpate certain landmarks on the cadavers prior to the removal of the skin for dissection." Table 5 Summary of the distribution of learning programmes across Health Science Faculties Types of learning programmes reported by respondents Combinations of learning

programmes reported by respondents (Frequency and %) 1. Didactic learning 2. Problem-based learning (PBL) 3. Vertical integration 4. Integrated teaching 5. Inter-professional education (IPE) 6. Peer group teaching 7. Peer group tutoring 8. Tutoring by lecturers of teaching assistants (TAs) 9. Team-based learning (TBL) 10. Case-based learning (CBL) 1,2 3,4,5,6,7,8,9,10 (n=1,16.7%) 1,2, 6, 8, 9,10 (n=1, 16.7%) 1,2,8 (n=2, 33.4%) 1,2,3,5,6,7,8,9 (n=1,16.7%) 4,6,7,8,10 (n=1,16.7%) LITERATURE CITED Azu OO, Peter AI, Etuknwa BT, Ekandem GJ. 2012. Plastinated specimens for anatomical education: the view of medical students. Clin Anat 25: 918. Bergman EM, Van Der Vleuten CPM, Scherpbier AJJA. 2011. Why don't they know enough about anatomy? A narrative review. Med Teach 33:403-409. Bekele A, Reissig D, Löffler S, Hinz A. 2011. Experiences with dissection courses in human anatomy: A comparison between Germany and Ethiopia. Ann Anat 193:163-167. Biasutto SN, Caussa LI, Criado del Rio LE. 2006. 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