EXPERIENTIAL LEARNING IN AN UNDERGRADUATE BPHARM PROGRAMME: IMPACT OF AN INTERVENTION ON ACADEMIC ACHIEVEMENT

All genuine education comes about through experience (John Dewey, 1938)

EXPERIENTIAL LEARNING IN AN UNDERGRADUATE BPHARM PROGRAMME: IMPACT OF AN INTERVENTION ON ACADEMIC ACHIEVEMENT

Jane McCartney

Submitted in fulfilment of the requirements for the degree

Doctor of Philosophy (General Health Sciences)

in the Faculty of Health Sciences at the

Nelson Mandela Metropolitan University

July 2016

Supervisor: Prof S-A Boschmans

DEPARTMENT OF ACADEMIC ADMINISTRATION
EXAMINATION SECTION – NORTH CAMPUS
PO Box 77000
Nelson Mandela Metropolitan University
Port Elizabeth 6031
Tel. +27 (0) 41 504 3206 / 504 3392
Fax. +27 (0) 41 504 9206 / 504 3064

Nelson Mandela Metropolitan University
for tomorrow

DECLARATION BY STUDENT

NAME: Jane McCartney

STUDENT NUMBER: 187028220

QUALIFICATION: PhD (General Health Sciences)

TITLE: Experiential learning in an undergraduate BPharm programme: impact of an intervention on academic achievement

DECLARATION:

In accordance with Rule G4.6.3, I hereby declare that the above-mentioned thesis is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

SIGNATURE: ……..

DATE: ……..

ACKNOWLEDGEMENTS

Many friends and colleagues have supported and encouraged me on this doctoral journey, but I would like to make specific mention of:-

My supervisor and colleague, Prof Shirley-Anne Boschmans, for her expert guidance, support and advice;

The final year NMMU pharmacy students of 2013, 2014 and 2015, as the research participants. It was a privilege and an honour to have worked so closely with you. The research would not have been possible without your willingness to participate, your enthusiasm, energy and interest;

Dr Jacques Pietersen, consultant statistician from the Unit for Statistical Consultation, for his advice, patience and expertise;

The Research Office at NMMU and the National Research Foundation of South Africa for administrative and financial support;

Last but by no means, least, my family. My husband Chris, for his unwavering belief in me; my sons, Ryan and Kevin, who kept me motivated and smiling; my wonderful sisters and Mum for always being there when I needed them and my late Dad, my role model who practised clinical pharmacy long before the concept was introduced to the professional practice of pharmacists.

ABSTRACT

Background and Problem Definition

The extended role of today's pharmacist with the emphasis on patient-focused care has highlighted the need for increased exposure of undergraduate pharmacy students to experiential learning in patient-centred environments, and additional skills development in therapeutics, problem solving and clinical decision making. At the Nelson Mandela Metropolitan University (NMMU), final year pharmacy students complete a university-coordinated, hospital-based, structured experiential learning programme (ELP) for the exit-level module, Pharmacology4. However, the students consistently experience difficulties in the application of pharmacological knowledge during the transition from lecture-based learning to the patient-focused clinical setting. The student population at the NMMU is diverse, with varied cultural, ethnic, language and secondary level education backgrounds, as well as different learning preferences and approaches. The extent to which these factors affect academic achievement in the experiential learning environment is unknown.

Central research question

The central research question for this study was therefore, "What would be the effect of an intervention aimed at supporting undergraduate pharmacy students during clinical placements, on academic achievement in, and student attitudes towards, experiential learning programmes (ELP)?" In order to explore the research question, several factors which may influence academic achievement in ELPs were investigated, namely: academic achievement (pre-university, in the BPharm programme and, in pharmacology); the admission route into the BPharm programme and the subsequent rate of academic progression; English reading comprehension ability; learning styles; problem

solving ability; the extent to which students are prepared for application of knowledge in the ELP, in terms of assessment methods used prior to the final year and previous pharmacy work-based experience. In addition, the students' lived experience of the ELP was explored, and the need for, and nature of, an intervention was determined.

Research methodologies

The research was based in a pragmatic paradigm, using an advanced mixed methods approach. An intervention-based, two-phase, quasi-experimental design was employed with an initial exploratory Preliminary Phase (in 2013) preceding the larger experimental framework (Phases One and Two, in 2014 and 2015 respectively). The research design was primarily quantitative, with pre- and post- testing conducted before and after the ELP. The ELP was completed by the comparator cohort in Phase One and the experimental cohort in Phase Two. Supplementary qualitative data was collected before, during and after the ELP. The intervention, in the form of supplementary academic support sessions, was developed from the qualitative data using an iterative approach, and implemented during the ELP in Phase Two.

Results

Attitudes and expectations of the students towards the hospital-based ELP were generally positive and realistic. Areas of concern included the difficulties experienced in the application and integration of pharmacological knowledge, both in the clinical setting and the clinical case study-based assessments; students feeling overwhelmed, inadequate and inferior in the clinical environment, compounded by an absence of clinical pharmacists as role models; and feeling unprepared for patient-focused care. The qualitative data strongly supported the need for supplementary academic support sessions. The intervention was developed and implemented in Phase Two, using patient case-based,

active learning strategies. The majority of students (91.0%; n = 104) reported improved case analysis skills. A statistically significant (p = .030, Cohen's d = 0.34) improvement was noted in the summative Pharmacology4 assessment marks obtained by the experimental cohort post-intervention, although of small practical significance. Predictors of academic achievement in the ELP were found to be language, specifically English reading comprehension skills, academic achievement in the BPharm programme and pharmacology, the university admission score, the rate of academic progression, and problem solving ability. Previous pharmacy-based work experience and assessment questions requiring application of knowledge were also found to influence achievement in the ELP.

Conclusion

The need for an intervention in the form of supplementary academic support sessions was confirmed. The intervention was subsequently developed and successfully implemented, with student-reported self-perceived improvements in patient case analysis skills. These positive findings were supported by quantitative data which showed a statistically significant improvement in academic achievement in the ELP. Several predictors of academic achievement in the ELP were identified, and invaluable insight was gained into the nature of the difficulties experienced by pharmacy students in the transition from lecture-based learning to experiential learning in patient-focused environments.

TABLE OF CONTENTS

CHAPTER FOUR: RESULTS (QUALITATIVE)

LIST OF ANNEXURES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AC	Abstract conceptualisation
AE	Active experimentation
APPE	Advanced Pharmacy Practice Experiences
APM	Raven's Advanced Progressive Matrices
APS	Admission Points Score
BPharm	Bachelor of Pharmacy degree
CBL	Case based learning
CCTDI	California Critical Thinking Dispositions Inventory
CCTST	California Critical Thinking Skills Test
CE	Concrete experience
CPM	Coloured Progressive Matrices
EFL	English First Language
EL	Experiential Learning
ELP	Experiential Learning Programme
ESL	English Second Language
FIP	International Pharmaceutical Federation
GPhC	General Pharmaceutical Council
GPA	Grade Point Average
ILS	Vermunt's Inventory of Learning Styles
IPPE	Introductory pharmacy practice experiences
LSI	Kolb's Learning Style Inventory
MBTI	Myers-Briggs Type Indicator
MPharm	Masters in Pharmacy degree

NAPLEX	North American Pharmacist Licensure Examination
NMMU	Nelson Mandela Metropolitan University
NSC	National Senior Certificate
OTC	Over-the-counter medication
PBL	Problem based learning
PCAT	Pharmacy College Admission Test
PharmD	Doctor of Pharmacy degree
PILS	Pharmacists' Inventory of Learning Styles
RO	Reflective observation
RPM	Raven's Progressive Matrices
SADC	Southern African Development Community
SAPC	South African Pharmacy Council
SAQA	South African Qualifications Authority
SOAP	Subjective, Objective, Assessment, Plan
SPM	Raven's Standard Progressive Matrices
TBL	Team based learning
UK	United Kingdom
USA	United States of America
WGCTA	Watson Glaser Critical Thinking Appraisal
WIL	Work integrated learning

CHAPTER ONE: INTRODUCTION AND OVERVIEW

1.1 INTRODUCTION

The first chapter will describe the context in which the research was conducted before presenting the research problem, the central research question and sub-questions. The aim and objectives of the research are then described, along with an overview of the mixed methods research design. Background information on the Bachelor of Pharmacy (BPharm) curriculum offered by the Nelson Mandela Metropolitan University (NMMU) is provided in order to understand the focus of the research, namely the experiential learning programme (ELP) component of the Pharmacology4 module. Lastly, an overview of the data collected is presented in order to demonstrate the type and timing of the quantitative and qualitative data. Key terms that are frequently used throughout the thesis are included at the end of the chapter.

1.1.1 The context of the research

The role of the pharmacy profession has expanded considerably in the last 40 years. Pharmacists are no longer restricted to the product-focused provision of medicines but now offer a range of patient-focused services which identify and optimise the medication-related needs of the patient (S. Hudson, McAnaw, & Johnson, 2007; Ried & Posey, 2006; Wiedenmayer, Summers, Mackie, Gous, & Everard, 2006). This extended role of the pharmacist, with an emphasis on patient-focused care, requires the development of additional skills in the areas of clinical therapeutics, problem solving and clinical decision making and interdisciplinary teamwork. This is in contrast with the traditional pharmacy curricula which focused on extensive knowledge acquisition with attention to detail and accuracy, but little or no clinical involvement (K. Hall, Musing, Miller, & Tisdale, 2012). In response to these

changes in the professional functions of pharmacists, pharmacy educators have had to revise undergraduate curricula in order to meet the profession's need for new skills.

The expanding role of the pharmacist has also highlighted the need for increasing the exposure of undergraduate pharmacy students to experiential learning in a patient-centred environment, achieved through clinical placements at practice sites. Experiential education was defined in the American College of Clinical Pharmacy's White Paper on Quality Experiential Education as "a methodology in which educators engage learners in direct experience and targeted reflection in order to increase knowledge and to develop skills, behaviours and values" (Haase, Smythe, Orlando, Resman-Targoff, & Smith, 2008, p. 220e). Several countries such as North America, Australia, New Zealand and the United Kingdom have identified the need for more experiential education in undergraduate pharmacy curricula, with varying degrees of implementation (Haase et al., 2008; K. Hall et al., 2012; Oderda et al., 2010; Owen & Stupans, 2009; Sosabowski & Gard, 2008). In South Africa, the revised BPharm degree was registered with the South African Qualifications Authority in June 2012. The registered BPharm qualification now stipulates that providers must include structured experiential learning periods in their curricula, accumulating to a minimum of 400 hours in the overall programme (SAQA, 2012).

1.1.2 Problem definition

The student population at the NMMU is diverse, with varied cultural, ethnic, language and secondary level education backgrounds, as well as different learning preferences and approaches. The extent to which these factors affect academic achievement in the experiential learning environment is unknown. Previous research has investigated factors contributing to academic success in pharmacy programmes (McCall, Allen, & Fike, 2006) but there is little

research into predictors of academic success in experiential learning programmes in pharmacy education.

Pharmacology is one of four major subject areas in the four year BPharm degree offered by the NMMU in South Africa. Pharmacology is presented as three year-long modules, starting in the second year (BPharm2) of undergraduate studies with the module Pharmacology2. A university-coordinated, formal, structured experiential learning programme occurs in the final year (BPharm4) module, Pharmacology4 (Applied Therapeutics), where the focus shifts to Clinical Pharmacology and the fourth year students complete a 15 week, 180 hour clinical placement in local public sector hospitals. The Pharmacology4 learning outcomes state that students are required to apply discipline-specific knowledge gained in Pharmacology2 and Pharmacology3 in order to identify and resolve medication-related problems encountered in the clinical setting. However, the final year pharmacy students experience difficulty in the application and integration of pharmacological knowledge when placed in a clinical setting where they are required to identify and resolve medication-related problems through clinical decision making.

1.2 CENTRAL RESEARCH QUESTION AND SUB-QUESTIONS

The central research question for this study was:-

What would be the effect of an intervention aimed at supporting undergraduate pharmacy students during clinical placements, on academic achievement in, and student attitudes towards, experiential learning programmes?

The following research sub-questions were identified:-

- To what extent does academic achievement in Pharmacology, and in the BPharm programme, predict academic achievement in the ELP?
- To what extent does the Admission Points Score (APS), the BPharm admission route and the rate of academic progression through the BPharm programme, predict academic achievement in the ELP?
- How do factors such as English reading comprehension, previous work based experience in a pharmacy environment, learning styles and problem solving ability, influence academic achievement in the ELP?
- Do the assessment methods used in summative pharmacology examinations in the preceding academic years prepare pharmacy students for clinical case-based assessments, which require application of knowledge through problem solving and clinical decision making?
- What are the students' experiences of the experiential learning programme?
- To what extent could supplementary academic support influence academic achievement in the ELP?

1.3 RESEARCH AIM AND OBJECTIVES

The aim of the research was, therefore, to develop and implement an intervention (in the form of supplementary academic support sessions) and, to determine the extent to which the intervention influenced academic achievement in, and student attitudes towards, the clinically focused ELP.

The research objectives were to:-

1) Compare the level of academic achievement in the ELP to academic achievement in the BPharm programme, and in Pharmacology.

2) Evaluate the relationship between academic achievement in the ELP and Admission Points Score (APS), the BPharm admission route (four or five year BPharm degree programme) and, the rate of academic progression through the BPharm programme.
3) Determine the extent to which English reading comprehension ability influences academic achievement in the ELP.
4) Determine the extent to which problem solving abilities of final year pharmacy students influence academic achievement in the ELP.
5) Evaluate if students' learning styles can be used to predict academic achievement in the ELP.
6) Investigate if prior work exposure in a pharmacy practice environment in the form of externships influences academic achievement in the ELP.
7) Determine the extent to which students are expected to apply pharmacological knowledge in summative examination questions used in undergraduate second and third year pharmacology examination questions.
8) Explore the students' experiences of the ELP in order to describe student attitudes towards, and expectations of, the clinical placements.
9) Develop, implement and evaluate an intervention aimed at providing supplementary academic support during the ELP.

1.4 RESEARCH DESIGN

The research was based in a pragmatic paradigm, with the research problem as the focus. A mixed methods approach was adopted, incorporating both qualitative and quantitative research methodologies into the study design. Mixed methods research can be defined as:

> An approach to research in the social, behavioural and health sciences in which the investigator gathers both quantitative (close ended) and qualitative (open ended) data, integrates the two and then draws interpretations based on the combined strengths of both sets of data to understand research problems (Creswell, 2015, p. 2).

The approach allowed the researcher to collect different types of data using various methodologies, with the aim of producing a result that combined the strengths of quantitative and qualitative methodologies. In this research, the objective measures of academic achievement in the ELP such as assessment marks and test scores were collected using quantitative methodologies, and this data was further enhanced by the subjective nature of the participants' perceptions and experiences of the ELP gathered through qualitative methodologies such as focus groups and open-ended questions. In addition, the qualitative data obtained from the descriptions of the students' experiences of the ELP contributed to the design of the intervention. The overall result, derived from employment of mixed methods, thus provided a far greater understanding of the factors contributing to the research problem.

An advanced mixed methods design incorporating an intervention was used (Creswell, 2015) (Figure 1.1). A two-phase quasi-experimental design was employed with an initial exploratory Preliminary Phase preceding the larger experimental framework (Phases One and Two). The experimental framework took place over two consecutive academic years (2014 and 2015). The research design was primarily quantitative (with pre- and post- test measures conducted in the comparator (control) and experimental cohorts), with a supplementary qualitative component included before, during and after the intervention.

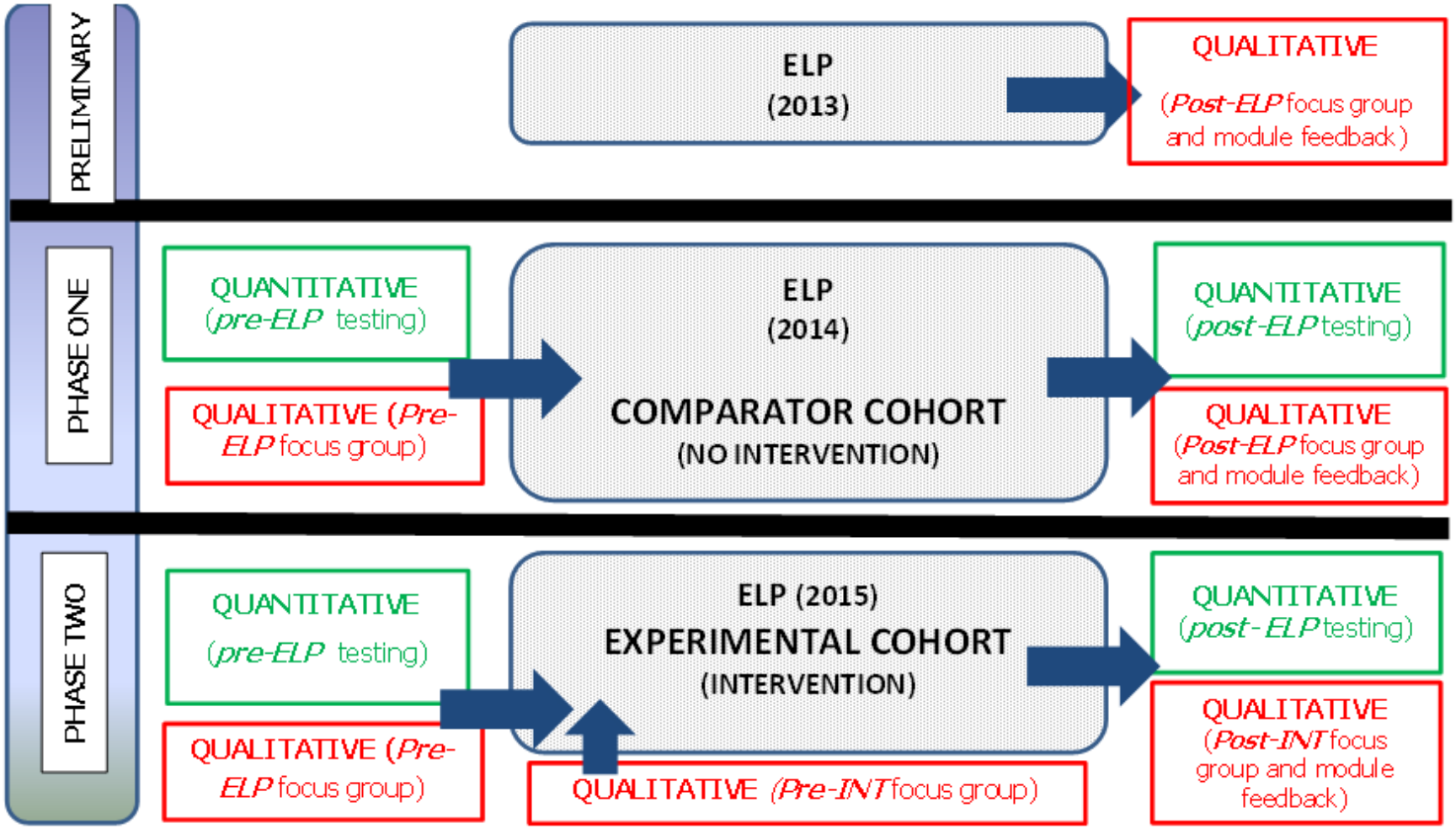


Figure 1.1

Overview of the intervention-based mixed methods design showing the three phases – the initial preliminary phase followed by the quasi-experimental phases with comparator and experimental cohorts and timing of the qualitative and quantitative methodologies. (ELP: Experiential Learning Programme; INT: Intervention)

A concurrent triangulation approach (Creswell, 2009) was applied, where the qualitative and quantitative methodologies were administered in a parallel manner in the same time frame, as part of the same study. Triangulation can be defined as "seeking convergence and corroboration of results from different methods and designs studying the same phenomenon" (Johnson & Onwuegbuzie, 2004, p. 22). Due to the potentially beneficial nature of the intervention, random assignment of participants to comparator and experimental cohorts was not ethically feasible, hence the quasi-experimental nature of the design.

The research site was NMMU in the Eastern Cape province of South Africa. The sample consisted of final year BPharm4 students who were registered for the first time for Pharmacology4 and had provided written informed consent to participate in the research. The focus of the research was the ELP which is presented over two of the four terms in the academic year, over a total of 15 weeks from April to September. The preliminary exploratory phase took place during October 2013, when qualitative data was collected which informed the development of the questions for the subsequent focus groups and also contributed to the design of the intervention in 2015. Phase One took place in 2014 with the comparator cohort of students, and the ELP was presented as usual with no intervention. Phase Two took place in 2015 with the experimental cohort of students, and the intervention was developed and implemented during the ELP in 2015 (Figure 1.1). The format of the intervention was the introduction of supplementary academic support sessions. Pre and post-ELP testing was conducted in both phases of the research in order to draw comparisons between the 2014 cohort (the comparator group) and the 2015 cohort (the experimental group which participated in the intervention). Chapter Three provides more details on the different phases of the research and the types of data collected.

1.5 ETHICAL CONSIDERATIONS

Ethical approval for the research was granted by the NMMU Research Ethics Committee (ethics clearance reference number: H13-HEA-PHA-008, Appendix A). The final year pharmacy students were informed of the reason for the research verbally and in writing, and that participation was voluntary, hence they could withdraw from participation at any time. Written informed consent was obtained from all participating students (Appendix B). Student confidentiality was maintained by assigning a unique research number as a data identifier, linked to each participant's student number. The allocation of the unique research number was undertaken by an independent third party, who was not involved with the research or the participants. The researcher then worked with the dataset of unique research numbers in order to maintain student confidentiality.

1.6 BACHELOR OF PHARMACY CURRICULUM AT NMMU

Background information on the undergraduate pharmacy curriculum at NMMU is required in order to understand the context of the focus of the research (i.e. the hospital-based ELP). The detailed structure and activities of the ELP will therefore be described, as well as an overview of the BPharm curriculum offered by NMMU.

1.6.1 Structure of the BPharm curriculum at NMMU

In South Africa, the BPharm degree is a four year, full-time, university-based programme. At NMMU, students not meeting all the academic requirements for direct entry into the four year BPharm programme are registered for the five year Extended BPharm programme, during which the first year modules are completed over a two year period, and additional academic support is provided.

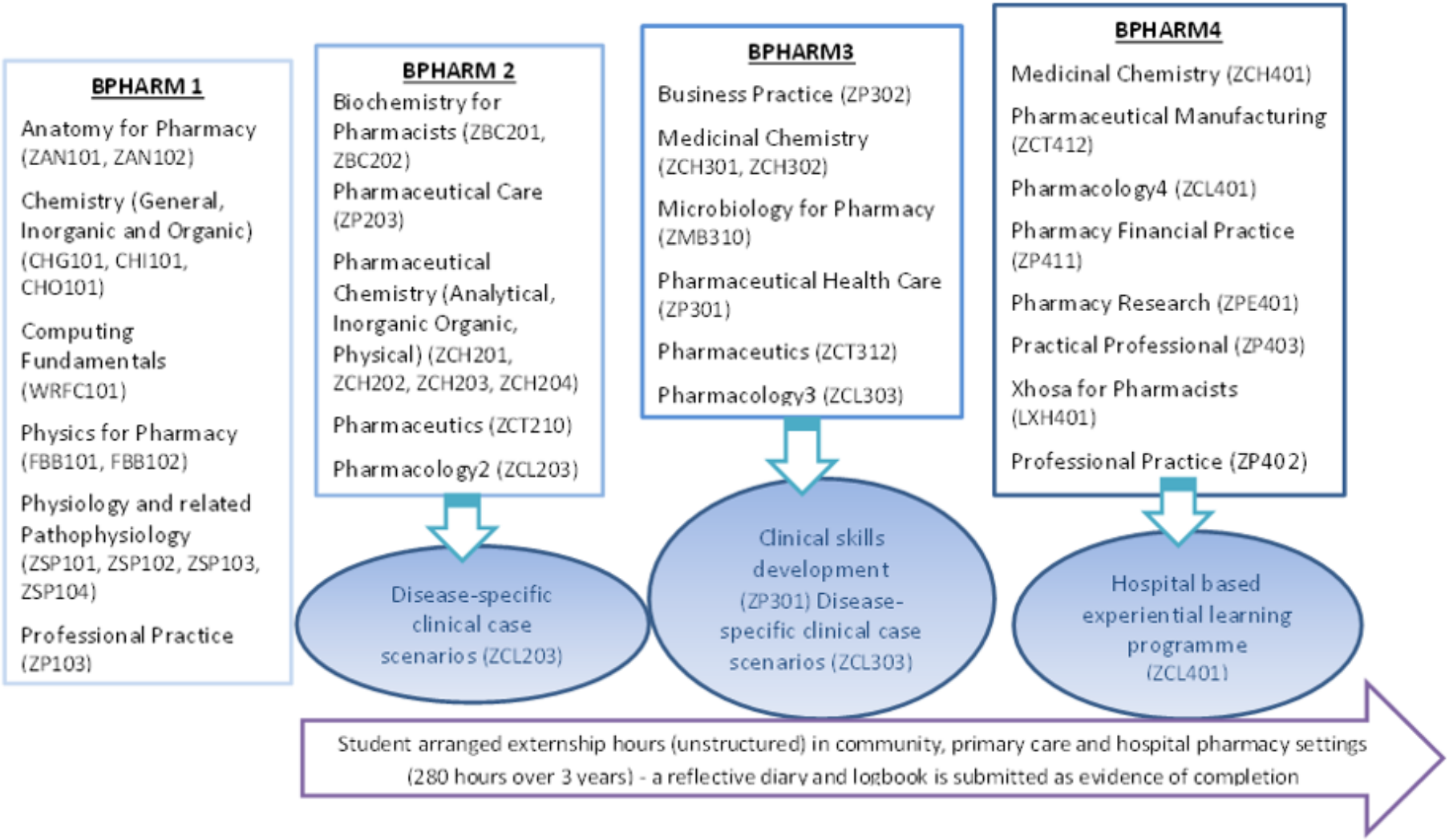


Figure 1.2

The BPharm curriculum at NMMU showing the progressive development of clinical knowledge and skills (theory and application).

Figure 1.2 provides the curriculum of the BPharm degree offered at NMMU, and also details the progressive development of clinical skills over the four year degree programme, during the Pharmacology and Pharmacy Practice laboratory-based practical sessions as well as the unstructured externship hours that are completed by the students.

During the first three years of the BPharm programme, pharmacy students are prepared for the ELP by the Pharmacy Practice and Pharmacology staff using a variety of practicals and assignments aimed at developing student knowledge and the relevant clinical skills that are required for patient-focused pharmaceutical care. Table 1.1 provides details of the approaches used in the development of clinical skills during the earlier years of the BPharm programme.

In addition to the formal academic content of the curriculum, BPharm students at NMMU are also required to arrange and complete externship hours in a community, primary care or hospital setting of their choice. A minimum of 280 externship hours must be completed over a three year period, so that by the end of BPharm3, on entry to the final academic year, students must have completed 200 hours (Department of Pharmacy, 2014). A reflective diary and logbook are submitted on completion of each academic year as proof of completion of the hours and for assessment purposes. These externship hours are not structured, and are arranged by the student. This means that the student experience may vary considerably from site to site. In addition, some students seek regular part-time employment in local community or hospital pharmacies, and may therefore accumulate additional externship hours.

Table 1.1
Practical development of clinical skills and knowledge in the BPharm programme at NMMU

	Pharmacy Practice	**Pharmacology**
BPharm1	*None*	*None*
BPharm2	*None*	*University based Practicals* Second semester: introduction to clinical scenarios, focused on a particular disease state. Exposure to South African National Treatment Guidelines (eg asthma, hyperlipidemia, hypertension). *Assessment* : written short answers.
BPharm3	*University based Practicals* Communication Role-playing scenarios Point-of-Care testing Patient counselling Pharmacist-initiated care (OTC) *Assessment:* Practical examination	*University based Practicals* Clinical scenario-based practicals Practical exposure to South African National Treatment Guidelines (HIV, TB, etc) Use of electronic databases for sourcing medicine information *Assessment:* patient case presentations, using the SOAP approach.
BPharm4	*Placement at Primary Care Clinic*	*Hospital-based activities (ELP)* Written patient evaluations and care plan, using SOAP approach Screening of patient files Written responses to drug information requests Documentation of pharmacy student interventions *University-based* Patient case presentations , based on SOAP approach used for written patient evaluations *Assessment:* open book, written clinical case studies

NMMU: Nelson Mandela Metropolitan University. SOAP: Subjective, Objective, Assessment, Plan

1.6.2 Pharmacology4 and the Hospital based Experiential Learning Programme

Pharmacology4 is a year-long module which provides 40 of the 124 credits in the final year of the BPharm degree at NMMU. The aim of the Pharmacology4 module is to enable the final year BPharm student to integrate and apply the knowledge from Pharmacology2 and Pharmacology3 in a patient-focused setting. Thus the mode of delivery of the module is predominantly experiential and patient-focused rather than lecture-based, and the module objective is to develop problem solving skills in order to optimise therapy using a rational evidence-based approach to clinical decision making. The problem solving approach to optimising medication use and the associated clinical decision making is developed through extensive exposure to the patient files (i.e. medical records) as well as communication with the medical, pharmacy and nursing staff, and the patients.

Four local public sector hospitals provide the clinical setting for the ELP. Students work in groups (maximum of five students per group), and according to their scheduled rotations, move through various clinical sites every two weeks over a 15 week period. The clinical sites include Internal Medicine, Orthopaedics and Surgery, Renal Unit, Oncology and Haematology, Pharmacy, Obstetrics and Gynaecology, Paediatrics, Psychiatry, Cardiac and Neurology. A university staff member is allocated to each hospital as the on-site clinical coordinator (preceptor), and is responsible for between 15 to 25 final year pharmacy students at the specific hospital. Students spend 3.5 hours in the hospitals on Tuesday, Wednesday and Thursday mornings, and then meet back on campus every Friday for a 2.5 hour report-back session with the academic pharmacy staff. Various clinical activities must be completed during each two week rotation at a clinical site (Table 1.2). Students are required to submit a written patient case evaluation each week, using the SOAP approach for the review and analysis of the clinical information (i.e. Subjective, Objective, Assessment and Plan) (Table 1.2). Daily screening of patient files in the relevant ward also encourages a review of prescribed medication, in order

to identify medication-related issues that need to be addressed (Table 1.2). Due to the lack of clinical pharmacists in the hospital setting, the BPharm students accompany the medical doctors on the ward rounds and approach the on-site clinical coordinator, prescribers or nursing staff with any queries that arise.

Table 1.2
Clinical activities in the hospital-based ELP

Clinical activity	**Purpose and description of activity**
Ward round	Ideally, the students join the medical doctors on the ward round. On the days when there is no ward round, the students move from patient to patient, reviewing the medical records.
Screening of patient files.	This is a daily function and focuses the student on the medication prescribed, the diagnosis and co-morbid conditions. The intention is to familiarise students with commonly prescribed medications and doses for specific conditions. This activity also provides an overview of the patients in the ward so that the group can then identify a suitable patient case to follow-up for their detailed patient case review.
Pharmacist intervention	When screening patient files, students are expected to identify medication-related problems. Students then liaise with their clinical coordinator (NMMU Pharmacy Department staff member), before discussing the problem with the appropriate staff member at the hospital, who makes the ultimate decision to change therapy. The NMMU students are not directly involved in patient care but can discuss medication-related issues with the patient's medical doctor, hospital pharmacist or nursing staff, in order to optimise patient care. Students are expected to conduct medication reconciliations and take a patient history and counsel patients on the correct use of their medication.
Patient case reviews	A weekly written patient case review is completed, using the SOAP approach for the detailed write-up. These case write-ups (known as SOAP's) are assessed by the academic staff at NMMU. Cases are identified for presentation to the whole class at the Friday report-back sessions. These case write-ups require integration of clinical information in order to understand and optimise the patient care.
Drug information	Drug information is provided on request to medical, pharmacy and nursing staff. Written and appropriately referenced responses are provided by the students to the requester.
Pharmacist directed tasks	Students participate in site-specific activities which are identified by the hospital pharmacists. These activities may include compounding and manufacturing in the dispensary, conducting an audit of the ward stock to check for expired medication, preparation of patient counselling pamphlets or preparing an educational presentation for nursing staff or patients.

NMMU: Nelson Mandela Metropolitan University. SOAP: **S**ubjective, **O**bjective, **A**ssessment, **P**lan

Pre-placement lectures are conducted which provide comprehensive information about the placements and the various activities to be completed during the ELP. Students are also given two lectures on interpretation of laboratory investigations. The first visit to a patient's bedside takes place during an orientation week, which is aimed at familiarising the students with the ward setting and the medical files. Each group spends dedicated time (45 to 60 minutes) with the on-site clinical coordinator during this week.

1.6.2.1 Assessments in Pharmacology4

The method of assessment in Pharmacology4 differs from the traditional written, closed book, short answer examination format used in Pharmacology2 and Pharmacology3. The written assessments in Pharmacology4 use an open book format and each test or examination paper consists of three clinical case studies (Appendix C). Students are required to identify medication-related problems and make appropriate recommendations. Two formative assessments, with an optional third formative assessment, are written under test conditions before the final summative Pharmacology4 assessment in November (on completion of the year-long module). These case-study based assessments, therefore, require application of knowledge and problem solving in a patient focused setting. In addition to the written assessments, marks are also allocated to the weekly patient case review write-ups (Table 1.2) and a file of clinical evidence is submitted for assessment on completion of the ELP. This file is a compilation of the clinical activities completed during the ELP, and includes the pharmacist interventions performed, the daily screening of patient medical files, drug information responses and pharmacist directed tasks completed (Table 1.2).

1.7 METHODOLOGY

As described in Section 1.4, the research design combined both quantitative and qualitative methodologies using a mixed methods approach. This section provides an overview of the data collected. Table 1.3 provides an overview of the data collection, and links the research objectives to the data to be collected, the data collection tool and the sample.

1.7.1 Qualitative data

Qualitative data was collected in order to explore the students' experiences of the ELP and describe student attitudes towards and expectations of the clinical placements (objective 8). In addition, the data obtained informed the design and development of the intervention (objective 9). The methodologies employed included the Pharmacology4 module feedback questionnaire, the post-intervention feedback questionnaire and focus groups.

1.7.1.1 Feedback Questionnaires

The 2013 cohort of final year BPharm students completed the Pharmacology4 module feedback questionnaire at the end of the academic year, on completion of the ELP. Questions were open-ended and qualitative in nature, and requested feedback on the module including the ELP. This feedback was transcribed and subsequently coded for themes, which were used to guide the focus group discussion with a subset of the 2013 cohort. Module feedback was also obtained from the 2014 (comparator cohort) final year BPharm students in order to confirm that data saturation had been reached prior to development of the intervention in 2015 (Table 1.3, research objective 9). The data obtained was also used in the development of the intervention in 2015 (Table 1.3, research objective 9).

Table 1.3

Overview of Data Collection, linking the research objectives to the data to be collected, the data collection tool and the sample

Research Objectives	Methods	Source of Data Collection	Sample
1. Compare the level of academic achievement in the BPharm programme and in Pharmacology to academic achievement in the ELP	QUAN	i) Weighted averages for BPharm1, BPharm2 and BPharm3 ii) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2014; 2015)*
2. Evaluate the relationship between academic achievement in the ELP and Admission Point Score (APS), the BPharm admission route (4 or 5 year) and academic progression through the BPharm programme.	QUAN	i) Admission point score (APS) ii) BPharm registration code iii) Academic progression rate through BPharm degree iv) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2014; 2015)*
3. Determine the extent to which English reading comprehension ability influences academic achievement in the ELP.	QUAN	i) English reading comprehension test ii) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2014; 2015)*
4. Determine the extent to which problem solving abilities of final year pharmacy students influence academic achievement in the ELP.	QUAN	i) Ravens Standard Progressive Matrices ii) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2014; 2015)*
5. Evaluate if students' learning styles can be used to predict academic achievement in the ELP.	QUAN	i) Classification of learning styles of students (Kolb's Learning Style Inventory) ii) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2014; 2015)*
6. Investigate if prior work exposure in a pharmacy practice environment influences academic achievement in the ELP.	QUAN	i) Pre-ELP questionnaire	Registered for Pharmacology4 *(2014; 2015)*
7. Determine the extent to which students are expected to apply pharmacological knowledge in summative examination questions used in Pharmacology3 and Pharmacology2 modules	QUAN	i) Retrospective review of Pharmacology2 and Pharmacology3 written summative examination papers	Pharmacology2 & Pharmacology 3 Nov exam papers *(2012, 2013, 2014)*
8. Explore the students' experiences of the ELP in order to describe student attitudes towards and experiences of the clinical placements.	QUAL	i) Focus groups to explore expectations, concerns and experiences of the ELP ii) Pharmacology4 module feedback questionnaire	Registered for Pharmacology4 *(2013; 2014; 2015)*
9. Develop, implement and evaluate an intervention aimed at providing supplemental academic support in the ELP.	QUAL QUAL QUAN	i) Pharmacology4 module feedback questionnaire ii) Focus groups to explore the students' experience of the intervention iii) Post-intervention feedback questionnaire (*2015 cohort*) iii) Pharmacology4 summative assessment (Nov exam) mark	Registered for Pharmacology4 *(2013; 2014; 2015)*

ELP: experiential learning programme; APS: admission point score; QUAN: quantitative; QUAL; qualitative

A feedback questionnaire was also administered post-ELP, on completion of the intervention, to the 2015 (experimental cohort) students. Questions in the post-intervention feedback questionnaire focused specifically on the students' experience of the intervention (Table 1.3, research objective 9).

1.7.1.2 Focus groups

An exploratory focus group was conducted with a subset of participants during the preliminary phase in Oct 2013 (Table 1.3, research objective 8). Focus groups were also conducted pre- and post-ELP, with subsets of the cohort from the respective years in Phase One (2014) and Phase Two (2015). The pre-ELP focus groups explored the expectations and concerns of the final year students prior to the start of the clinical placements in 2014 and 2015, as well as their perceived level of preparedness (Table 1.3, research objective 8). The post-ELP focus groups conducted in 2013 and 2014 explored the students' experiences of the ELP (Table 1.3, research objective 8) and possible ways to improve the learning experience. The information obtained guided the development of the intervention (Table 1.3, research objective 9).

In Phase Two, a pre-intervention focus group was held in July 2015 after the first written formative assessment based on clinical case studies, in order to explore the students' experience of this format of assessment, and the role of the ELP in preparing the students for the assessment (Table 1.3, research objective 9). Data obtained during this discussion also contributed to the final design and implementation of the intervention (Table 1.3, research objective 9). Lastly, a post-intervention focus group was held in Oct 2015 of Phase Two, in order to explore the students' experience of the intervention (Table 1.3, research objective 9).

1.7.2 Quantitative data

This section describes the quantitative data that was collected in Phase One (2014) from the comparator cohort and in Phase Two (2015) from the experimental cohort. Data was collected pre-and post-ELP for comparison purposes. The methodologies utilised for data collection included a pre-placement questionnaire; the weighted average per academic year of the BPharm as an indicator of academic achievement in the BPharm programme; the Pharmacology2 and Pharmacology3 mark for the summative written examination as an indicator of academic achievement in Pharmacology prior to registration for Pharmacology4; the average Pharmacology4 mark for the summative written clinical case study-based examinations as an indicator of academic achievement in the ELP; the Admission Point Score (APS), the BPharm registration codes and rate of academic progression through the BPharm programme; Kolb's Learning Style Inventory scores; English reading comprehension scores; Raven's Standard Progressive Matrices as a measure of problem solving ability and a retrospective review of Pharmacology2 and Pharmacology3 summative examination papers.

1.7.2.1 Pre-ELP Questionnaire

Prior to the commencement of the ELP, a purpose-designed questionnaire was administered to all participating final year pharmacy students in the comparator group (2014) and the experimental group (2015) (Appendix D). The data collected provided information on the demographics of the study population in terms of age, gender, citizenship, mother tongue and language of education and, the extent and nature of work-based experience prior to the start of the ELP (Table 1.3, research objective 6). The questionnaire used closed-ended questions.

1.7.2.2 Academic Achievement

Academic achievement in the BPharm degree

Academic achievement in the BPharm degree was determined from the overall weighted average of module marks for each academic year, namely BPharm1, BPharm2, BPharm3. The data was accessed electronically from the NMMU Business Information system (Table 1.3, research objective 1).

Academic achievement in Pharmacology

The final mark obtained in the summative written November examinations for Pharmacology2 and Pharmacology3 was used as a measure of academic achievement in pharmacology. The examination marks were accessed from the NMMU Business Information database, in order to meet research objective 1 (Table 1.3).

Academic achievement in the ELP

The written assessments in Pharmacology4 evaluated application of knowledge and clinical decision making, through the use of an open book, clinical case study-based format. The Pharmacology4 assessment marks were obtained from the comparator (Phase One, 2014) and experimental cohorts (Phase Two, 2015).

The assessment marks used were the first formative assessment (written at the start of the ELP) and the final summative assessment (written post-ELP) during the November examination period. The identical assessment papers, with the same clinical cases, were administered to both cohorts to enable comparison between the two cohorts. The assessment papers were not circulated or made available to students prior to the assessment and were handed back at the end of the written assessment.

The formative Pharmacology4 assessment marks were required in order to compare the patient case analysis skills of the comparator and experimental cohorts at the start of the ELP, before the experimental cohort was exposed to the intervention. The final summative Pharmacology4 assessment marks (written post-ELP) during the November examination period were used as a measure of academic achievement in the ELP (Table 1.3, research objective 1).

1.7.2.3 Admission Points Score, Admission Route and Academic Progression

The Admission Points Score (APS) was used as an indicator of academic ability on entering university, while the BPharm registration code (i.e. admission into the four or five year BPharm programme) was used to determine the admission route of the students in order to determine the rate of academic progression through the BPharm programme. These indicators were investigated in order to establish if the rate of academic progression influenced academic achievement in the ELP (Table 1.3, research objective 2).

1.7.2.4 English Reading Comprehension

All participants completed an English Reading Comprehension assessment pre-and post-ELP. The assessment was developed and validated at NMMU (Foxcroft, Watson, Seymour, Davies, & McSorley, 2002), and is used as a means of evaluating reading skills and sentence meaning in prospective student assessment prior to enrolment in university programmes. The English Reading Comprehension test was conducted in order to meet research objective 3 (Table 1.3).

1.7.2.5 Problem solving ability

Raven's Standard Progressive Matrices (SPM) was used as a measure of problem solving ability, and the test was conducted pre- and post-ELP on all participants in order to

achieve research objective 4 (Table 1.3). The test was selected as it is recognised as a nonverbal assessment tool of problem solving ability. The nonverbal aspect minimises the impact of language skills on performance as the structure of the test is that of graphics arranged in a matrix (Carpenter, Just, & Shell, 1990).

1.7.2.6 Learning Styles

The concept of learning styles recognises that individuals differ in their approach to learning, based on their preferences for using different stages of the learning cycle, as described by D. Kolb (1984). Although many models and measures of learning exist, Kolb's model remains one of the most widely encountered (Romanelli, Bird, & Ryan, 2009), and has been used to assess learning preferences in pharmacy students (Austin, 2004b). In this study, each participating student completed a Kolb's Learning Style Inventory (LSI) pre- and post-ELP in order to identify the dominant learning styles of the final year BPharm students and if the ELP influenced the learning styles in any way (Table 1.3, research objective 5).

1.7.2.7 Retrospective review of pharmacology summative assessments

The 2012 and 2013 Pharmacology2, and the 2013 and 2014 Pharmacology3 summative November examination papers were reviewed and analysed using a modified approach based on Bloom's taxonomy, as described by Kim, Patel, Uchizono, and Beck (2012). This analysis was done in order to identify the extent to which the application of pharmacological knowledge for the purpose of problem solving is assessed in the pharmacology summative assessments prior to the ELP in Pharmacology4. The questions were categorised according to Bloom's cognitive domains (Bloom, 1956) as knowledge, comprehension, application, analysis and, synthesis and/or evaluation in nature. The number of marks in the examination paper that was allocated to each category was calculated and a percentage assigned per category. An indication

of the longitudinal development of application of knowledge over the Pharmacology2 and Pharmacology3 modules was then determined in order to meet research objective 7 (Table 1.3).

1.8 OUTLINE OF THE RESEARCH

Chapter One has provided an introduction to the context of the research and an overview of the research design. The central research question and sub-questions, the research aim and objectives were described, as well as a brief summary of the different methodologies employed. The ethical considerations required in conducting this research were also identified.

Chapter Two will provide a review of the literature, focusing on experiential learning in pharmacy education and factors which influence academic achievement. The topics reviewed include the impact of a changing professional practice environment on pharmacy education and the resulting response by pharmacy educators, the conceptual framework for experiential learning theory, and the role of experiential learning in pharmacy education.

Chapter Three will present a description of the mixed methods approach used and provides a clear and detailed breakdown of the data collection process and methods utilised in collecting the quantitative and qualitative data.

The results are presented and analysed over two chapters, namely Chapter Four for the qualitative data and Chapter Five for the quantitative data. The research findings are then integrated and discussed in Chapter Six, in line with the research objectives. Finally, Chapter Seven will present the final conclusions and recommendations arising from the research.

1.9 DEFINITION OF KEY TERMS

For the purposes of the research, the following key terms and phrases are operationally defined:

- *Academic achievement in the experiential learning programme* - measured by the Pharmacology4 marks for the open book, clinical case scenario-based assessments (which evaluate the students' ability to apply pharmacological knowledge when problem solving in the clinical environment)
- *Academic achievement in the BPharm programme* - measured by the weighted grade or module mark average for the academic year
- *Academic progression* - refers to the number of years that a student has been registered for the BPharm programme (on first registration for Pharmacology4).
- *Clinical placements* - refers to a professional practice placement undertaken within a workplace setting by allied health students such as pharmacy students.
- *Educator* - a specialist working in an academic environment and involved in the delivery of academic programmes.
- *Experiential learning* - learning through experience in a workplace environment. May also be referred to as Work Integrated Learning (WIL).
- *Experiential Learning Programme (ELP)* - the hospital-based experiential learning programme presented by NMMU in the Pharmacology4 module.
- *Pharmacy externship hours* - time spent by undergraduate NMMU pharmacy students in a pharmacy practice setting, such as a community pharmacy, primary health care clinic or hospital dispensary. The time spent is a course requirement of NMMU's Pharmacy Practice modules and in addition, also includes part-time employment during vacation periods or after normal trading hours.
- *Patient case reviews* - commonly known as SOAP write-ups (Subjective, Objective, Assessment, Plan). NMMU's Department of Pharmacy uses this standardised format of organising patient information which is based on a problem-orientated

approach to systematically classifying the type of information obtained from the medical records.

- *Preceptor* - an expert or specialist working in a profession such as pharmacy, who is involved with the supervision of students undergoing practical training and work-based experience in the pharmacy practice setting. May also be referred to as a clinical coordinator.
- *Report-back sessions* - the hospital-based ELP at NMMU includes a weekly report-back session of 2.5 hours, when the whole Pharmacology4 student group meets back on campus with the relevant pharmacy academic staff, for the purpose of learning from peers through group-led, case presentations, based on the written patient case reviews submitted each week for assessment.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will review the changes in the professional pharmacy practice environment and the resultant need for revision of curricula in pharmacy education. The discussion will then move to the theoretical framework for the research, namely the experiential learning theories. Research into the predictors of academic success in pharmacy education will then be presented as well as the issues to be considered when learning in the practice environment.

2.2 THE CHANGING PHARMACY PRACTICE ENVIRONMENT

2.2.1 Expanding role for pharmacists

The International Pharmaceutical Federation (FIP)'s Global Framework for Quality Assurance of Pharmacy Education emphasised that today's pharmacy graduates are expected to take responsibility for ensuring that therapeutic outcomes are achieved through the safe, effective and optimal use of medicines by patients (FIP, 2014). These professional responsibilities not only require graduates to have the relevant discipline-specific knowledge but in addition, as pharmacists, need to possess critical thinking and problem solving skills in order to apply pharmaceutical knowledge to the problems encountered in the practice or clinical setting (Blouin, Joyner, & Pollack, 2008; Frankel, Louizos, & Austin, 2014; Wiedenmayer et al., 2006). The American Association of Colleges of Pharmacy's Curricular Change Summit Report described the changes taking place in the profession and highlighted the impact these changes would have on pharmacy curricula. Pharmacy educators would now need to ensure the development of additional skills in order to meet the demands of professional practice (Oderda et al., 2010).

2.2.2 Changes in the entry level qualifications for registration as a pharmacist

The entry level qualification (also referred to as "professional" or "pre-service" or "entry-to-practice") in order to register as a pharmacist is considered to be a degree programme at the post-secondary (higher) education level (FIP, 2014). However, the specifics of the degree vary from country to country. Many countries still recognise the traditional BPharm degree as the entry level qualification, although curricula differ enormously from country to country. These countries include Canada (CPhA, 2016), Australia and New Zealand (APC, 2012) and most of Africa, including South Africa (Rennie & Anderson, 2013; SAPC, 2015). However, in some developed and developing countries, the changes seen in the professional practice environment and the associated need for advanced competencies has resulted in a revised entry level qualification which has superseded the BPharm degree. In the United Kingdom, the minimum qualification for registration as a pharmacist is the four year Masters in Pharmacy (MPharm) degree (GPhC, 2016). From 2003, the Doctor of Pharmacy (PharmD) became the minimum requirement for registration as a pharmacist in North America. The PharmD doctorate programme is usually three or four years, preceded by a two to four pre-pharmacy programme of pre-requisite modules and is distinct from the traditional bachelor's degree in pharmacy in that the curriculum is characterised by extensive clinical didactic-based courses, a year of practice-based experience in a variety of healthcare environments and, a focus on optimisation of patient care (NABP, 2016).

In the following discussions on pharmacy curricula and experiential learning in pharmacy education, all three qualification types (BPharm, MPharm and PharmD degrees) will be included. While clinical pharmacy competencies are traditionally developed at the level of MPharm and PharmD programmes, most of the developing countries within sub-Saharan Africa have high disease burdens, so the need for newly-qualified pharmacy graduates to

possess patient-focused, clinical skills is just as critical, even in the absence of suitably qualified clinical pharmacists in practice (Rudall, Rennie, Singu, & Kibuule, 2015).

2.3 CURRICULA CHANGES IN PHARMACY EDUCATION

2.3.1 Increased need for experiential learning in pharmacy education

The recognition of the extended role of pharmacists and the associated need for revision of pharmacy curricula has been accompanied by increased calls for more experiential education during undergraduate training of pharmacists. The Global Competency Framework (FIP, 2012) described 20 competencies in pharmacy education and emphasised that in order to meet and achieve these competencies, educational activities must include experience and skills, as well as knowledge, attitudes and values. The recognition of the importance of experiential education was later reinforced in FIP's Global Framework on Quality Assurance in Pharmacy Education, which included experiential learning in the description of quality education in pharmacy. The document identified that quality in education should be "based on three important foundations, namely Science (knowledge), Practice (skills and experience) and Ethics (attitudes and values)" (FIP, 2014, p. 14).

2.3.2 Experiential learning in pharmacy education in developed countries

Pharmacy educators in developed countries (considered to be "high income" economies) such as the United Kingdom (UK), the United States of America (USA), Australia, Canada and New Zealand, have responded positively to the need for more experiential education, although the degree of implementation has varied.

New Zealand and Australia

In 2005, the New Zealand and Australian Pharmacy Schools Accreditation Committee recommended that undergraduate pharmacy students undergo 250 hours of experiential

placement time, inclusive of hospital and community, and rural placements. All pharmacy schools have clinical placements in the final year of the four year BPharm programme but only some schools include introductory experiential placements within the first two years of the programme (Marriott et al., 2008). The Accreditation Standards for Pharmacy Programmes in Australia and New Zealand state that experiential learning opportunities must occur in community and hospital pharmacy settings (including rural or remote sites) in the entry level qualification, and recommend that experiential learning should start early in the programme (APC, 2012). However, the reality is that experiential placements tend to occur predominantly in community pharmacies due to logistical limitations in hospitals (Chaar et al., 2011; Marriott et al., 2008).

United Kingdom

In the United Kingdom, the General Pharmaceutical Council (GPhC) stipulated that all Schools of Pharmacy must provide clinical visits during the undergraduate MPharm programme (GPhC, 2011) and most schools of pharmacy include at least one week over the four years of study (Sosabowski & Gard, 2008). However, one of the challenges encountered has been the source of funding, as the pharmacy programme is funded by the Higher Education Funding Council for England, whereas for nursing and medical students, clinical training in practice sites is funded by the Department of Health. This funding problem was confirmed by a survey of schools of pharmacy and students, who identified the major barriers to implementation of clinical visits as: a lack of funding for clinical training of undergraduate pharmacy students (Langley, Jesson, & Wilson, 2010), a lack of access to service providers (community and hospital) and, logistical issues with large numbers of students needing to be placed in small groups at numerous sites. The student survey confirmed strong student support for placement education during the MPharm degree, with 54% of students recommending that professional placements be introduced in each year of the programme. A total of 84% of students (n = 622)

had experienced one formal placement, usually in the final year, and most of the placements were in a hospital setting. The duration and quality of the placement experience and student perceptions of the experience were not investigated. A closing statement by the authors really summed up the current status, in that "current placement teaching within the UK is very *ad hoc*" (Langley et al., 2010, p. 45)

North America

The American College of Clinical Pharmacy's White Paper on Quality Experiential Education mentions the Accreditations Council for Pharmacy Education standards, effective from July 2007, which state that pharmacy curricula for a four year PharmD programme must include a minimum of 5% (300 hours) of the curriculum which are allocated to introductory pharmacy practice experiences (IPPE), and 25% (36 weeks or 1440 hours) of advanced pharmacy practice experiences (APPE) (Haase et al., 2008). This effectively means that 30% of the academic programme before graduation involves experiential education. With respect to experiential education in pharmacy programmes, North America appears to have a formalised, well developed plan for experiential learning that has been widely implemented.

Canada

In Canada, the need for redesigned experiential training programmes has been recognised as an essential step in the evolution of pharmacists from dispensers of medicines to managers of medication therapy (K. Hall et al., 2012), with a recommendation from the Association of Faculties of Pharmacy of Canada that the entry level qualification for pharmacists become a PharmD degree by 2020 (AFPC, 2010), with supervised clinical placements. Experiential education in Canada has tended to vary considerably across pharmacy schools with some courses stipulating as much as 12 weeks of experiential education in the final year (Austin & Ensom, 2008). Accreditation standards for Canadian pharmacy institutions now require that students in the Bachelor of Science in Pharmacy degree programme must

complete a minimum of 640 hours (16 weeks) of practice experience over the programme, while entry-to-practice PharmD programmes complete a minimum of 1600 hours (40 weeks) of practice experiences (K. Hall et al., 2012).

2.3.3 Experiential learning in pharmacy education in developing countries

The emerging changes in the professional practice environment in the developed world and the resultant pharmacy curricula changes have been recognised and implemented by some developing ("low and middle income" economies) countries. In contrast to the developed countries, many of these countries face enormous healthcare delivery problems, complicated by low numbers of pharmacists and other healthcare professionals, so pharmacy education programmes by necessity, must be needs-based, typically with a greater emphasis on public health pharmacy and patient-centred health services (C. Anderson & Futter, 2009). Furthermore, pharmacy education in developing countries continues to be held back by resource constraints, both in terms of suitably qualified academic experts as well as funding and infrastructure (C. Anderson et al., 2012).

Compounding the problem is the lack of information on pharmacy education research in developing countries. A systematic review of published literature on pharmacy education in low and middle income countries found only 36 publications, 80% of which were letters to the editor, commentaries or viewpoints (Babar, Scahill, Akhlaq, & Garg, 2013). The Asian continent produced 39% of the publications, followed by the Middle East (25%), with Africa contributing only 8% of the publications. Thus the paucity of published literature and lack of empiric research raises more questions than answers but does provide some evidence of the development of clinical pharmacy activities in these areas.

India and South Asia

In India, the four year BPharm curriculum is not standardised across the country's universities, which include both public and private institutions (Basak & Sathyanarayana, 2010). Experiential learning is further hampered by large geographical distances between the universities and pharmacy colleges and the practice sites, so there is no compulsory training in the practice environment. The nature of undergraduate pharmacy training in India, is therefore, determined largely by the demands of the country's thriving pharmaceutical industry, and, therefore, remains focused on the pharmaceutical product. Ghayur (2008) argued that many developing countries first need to resolve pressing issues in higher education before changing pharmacy curricula to emulate the Western models. Most of the pharmacy schools in South Asian countries, particularly in Pakistan, do not have practice sites for the pharmacy students, and also battle with a shortage of academic expertise in pharmacy practice and clinical pharmacy. Similar problems have been reported in Malaysia, where students enrolled in the MPharm degree at the University of Nottingham's Malaysia campus found that there were a limited number of work placement opportunities and the work-based experience completed during vacation periods, tended to be informal, optional and unstructured, with a lack of suitably trained preceptors in practice (Ting, Wong, & Thang, 2009). Shorter, compulsory visits to hospital and community pharmacies were, however, arranged by the university during the first year of the formal teaching curriculum.

Middle East

Pharmacy education and practice in Middle Eastern countries was reviewed by Kheir et al. (2008), who reported a definite trend of increased and more structured experiential learning hours as well as patient care skills. However, the authors also highlighted the shortage of expertise in pharmacy academia as well as clinical preceptors in the practice environment. More recently, Kheir, Al Saad, and Al Naimi (2013) reported on developments in

pharmaceutical care in the Middle East (focusing on Oman, Egypt, Saudi Arabia, Qatar, United Arab Emirates, Lebanon, Kuwait and Jordan). Again, definite positive changes were observed as some of the universities moved towards replacing the traditional Bachelor of Pharmaceutical Science degree with the PharmD degree, ultimately resulting in pharmacy graduates with a clinical, patient-based focus.

Africa

There is a paucity of published literature on undergraduate pharmacy education in Africa. The sub-Saharan region of Africa was identified as the area with the lowest number of pharmacists by the FIP's Global Pharmacy Workforce Report (C. Anderson, Bates, Bruno, et al., 2009), with an estimated 1 pharmacist per 10 000 population. This is in comparison to pharmacist to population ratios in the USA of 9 to 10 000. Justifiably, the focus then becomes pharmaceutical supply management, rather than patient-focused pharmaceutical care (C. Anderson et al., 2012). It would appear that many providers of undergraduate pharmacy education in Africa still present traditional science-based courses, with little evidence in the published literature of recent curricula revision or inclusion of patient-centred learning experiences happening at the undergraduate level (Mkony, 2012).

However, there is some evidence of curricula reform, typically at African institutions with a collaborative partnership linking to an international educational institution from a developed country. One such example is in Ghana, where Owusu-Daaku and Smith (2007) described the introduction of a social pharmacy module using outdoor fieldwork for health promotion in Kumasi, Ghana. The Department of Clinical and Social Pharmacy was established at this institution in 2000.

Ethiopia, in 2009 /2010, implemented a new clinically orientated undergraduate BPharm curriculum (Gutema, Hadera, Dagne, & Mamo, 2011) and many graduates have subsequently been deployed to public hospitals in order to provide ward based clinical

pharmacy services. Several researchers have reported on the emerging role of the clinical pharmacists in Ethiopia and the provision of clinical pharmacy services (Bilal, Tilahun, Beedemariam, Ayalneh, & Hailemeskel, 2016; Gelaw, Tegegne, & Aynalem, 2016; Mekonnen, Yesuf, Odegard, & Wega, 2013).

In Kenya, the BPharm degree is offered by six accredited universities, and some evidence of the shift towards patient-focused exposure during undergraduate training is evident with student participation in ward rounds and work experience attachments (Ogaji, Kahiga, Gachuno, & Mwangi, 2016). In addition, collaborative teaching, research and student exchange models have been established with American institutions, which have resulted in increased exposure to clinical pharmacy during undergraduate training.

Some of South Africa's neighbouring countries like Botswana and Swaziland are currently in the early stages of their newly developed undergraduate programmes (Rennie & Anderson, 2013), while the University of Namibia's first BPharm graduates qualified in December 2014. While there is evidence that some African institutions are involved in postgraduate clinical pharmacy training with associated clinical placements (C. Anderson, Bates, Beck, et al., 2009), there remains a lack of evidence of structured experiential training programmes in undergraduate pharmacy education in sub-Saharan African countries (excluding South Africa), implying that pharmacy curricula in many of these countries have yet to follow the trends in developed countries.

South Africa

Pharmacy in South Africa is well established, with nine university-based providers of undergraduate pharmacy education, offering curricula which must be approved and accredited by the statutory body, the South African Pharmacy Council (SAPC). The latest revision of the four year Bachelor of Pharmacy degree was registered as a qualification with SAQA in 2012,

and in line with international trends, now specifies a minimum of 400 hours of work-integrated learning be included in the curriculum (SAQA, 2012). Also in line with FIP's Global Framework on Quality Assurance in Pharmacy Education, the South African Pharmacy Council (Board Notice 123 of 2014) recently published a draft document for comment entitled "Good Pharmacy Education Standards" (SAPC, 2014). These standards are aimed at ensuring quality in pharmacy education in South Africa and include minimum standards for work integrated learning (WIL) (i.e. experiential education).

2.4 EXPERIENTIAL LEARNING THEORIES

This section describes the theoretical framework in which this research is sited, namely experiential learning theories. As defined by Yardley, Teunissen, and Dornan (2012, p. 103), learning theories explain "how individual people learn individual things in individual ways as they react to individual perceptions of experiences throughout their lives". Much of the work of experiential learning theorists is based on the philosophical principle of constructivism which can be described as "philosophy or theory built on the premise that understanding and knowledge are constructed on the basis of our own experience" (Wagner, Kawulich, & Garner, 2012, p. 268). Learning then becomes a process of personal and individual transformation with constructivism providing the basis for experiential learning (EL).

Many of the experiential learning theories are based on the foundational works of John Dewey, Kurt Lewin and Jean Piaget, who amongst others, recognised that experience played a central role in their theories of human learning and development. Dewey is recognised as one of the most influential educational theorists of the twentieth century, having identified "the intimate and essential relation between the processes of actual experience and education" (Dewey, 1938, p. 20), and proposed that learning is enhanced by experience and subsequent thinking and reflection on that experience. Dewey also observed that learners who personally

and actively engaged and interacted with their environment, acquired applied rather than abstract knowledge (Dewey, 1938). This observation is extremely relevant in pharmacy education where the transition of students from the lecture-based university context to the professional practice setting demands the application of pharmaceutical knowledge.

Lewin's work on group dynamics and action research as a means of bringing about change, demonstrated a consistent emphasis on the integration of knowledge and practice. One of the ways Lewin achieved this was through the development of training groups which encouraged interactive dialogue when conflict arose between learners (with their actual experiences) and teachers (with their conceptual or abstract models of learning)(D. Kolb, 1984; Lewin, 1944). The key role of experiences and its relationship to learning was also explored by Piaget, who was intrigued by the relationship between knowledge and learning. His theory on cognitive development focused on the way in which intelligence is influenced by experience and that intelligence develops as the person interacts with their environment (Yardley et al., 2012).

David Kolb's influential book entitled "Experiential Learning: Experience as the source of learning and development" defined learning as "the process whereby knowledge is created through the transformation of experiences" (D. Kolb, 1984, p. 38). He proposed a model of experiential learning that was inspired by the works of Dewey, Lewin and Piaget amongst others, in which learning occurred in a four stage cycle, beginning with a *concrete* experience (CE), followed by *reflective* observation (RO), which led to *abstract* conceptualisation (AC) followed by active *experimentation* (AE). Kolb's model of learning therefore proposed that learning ideally happens when all four of these modes of learning are involved.

Another valued contribution to experiential learning theory is the concept of a learning space, developed from Kurt Lewin's field theory and concept of life space, where person and

environment are seen as interdependent variables. Behaviour is then seen as a function of person and environment and life space is the total psychosocial environment which the person experiences subjectively (T. E. Smith & Knapp, 2010). This concept again reinforces the importance of the interaction between the person and the environment (A. Kolb & Kolb, 2005).

Vygotsky (1978) in his social-constructivist learning theory, described learning as a social and cultural process rather than an individual process, and proposed that social and cultural interactions were fundamental to understanding how learning occurs. Experience was deemed necessary but insufficient when making meaning in order to learn because the social interaction with others was a critical component. Vygotsky highlighted the importance of planning an experience within a specific context, using people, references, mentors and resources to enhance the learning. This concept was further developed by Lave and Wenger (1991) who published their Situated Learning theory (also known as Communities of Practice or Legitimate Peripheral Participation). The theory proposed that knowledge exists in communities of practice, so learning must exist outside the teacher and classroom. The community of practice then assists and facilitates the transition from novice to expert through mentorship and experience in the activities of practice, as well as the on-going development of practice as the newcomers replace the older practitioners (T. E. Smith & Knapp, 2010). This model of situated learning theory is very relevant to pharmacy education, where pharmacy students graduate and leave the university environment to become pharmacist interns in the professional practice environment, where they work and continue to learn under the close supervision of a more experienced pharmacist as their tutor, or in the final year of the PharmD programme, where learning takes place under the supervision of a preceptor.

Another theory, developed more recently by Itin (1999), proposed the Diamond Model for Experiential Learning, which was also based on Dewey's work. The model describes the relationships between educator, learner, learning environment and subject matter, where the

flow of information in work-based learning typically occurs in both directions. Similarly, Raelin proposed a model of single, double and triple loop learning and described single loop learning which is typically lecture-based, when very little thought or reflection occurs, in contrast to second loop processes which occur during experiential learning, when reflection and creative thinking are stimulated as problem solving occurs. In-depth reflective analysis then leads to triple loop learning (Raelin, 2000). Raelin's model reinforced the current belief that experiential learning not only involves the process of learning through experience but also through reflection, thus supporting this concept originally proposed by Dewey.

While the academic debate on the respective merits of the numerous theories of experiential learning continues, commonalities do exist. The theories are based in constructivism, where learning is situated in a social context, with action and participation as key elements required for learning. Learners and practitioners co-exist in these social groups where learning happens, so that the learning environment influences the learner, and the learner influences the environment (Yardley et al., 2012). Reflection is usually seen as a key contributor in the experiential learning process. Lastly, it is interesting to note that the founding concept, namely that experience plays a vital role in human learning, has never been challenged by the numerous theorists. As John Dewey simply stated "all genuine education comes about through experience" (Dewey, 1938, p. 13).

2.5 ACADEMIC ACHIEVEMENT IN UNDERGRADUATE PHARMACY EDUCATION

There are numerous publications dealing with the topic of academic achievement in pharmacy education. Most of the published literature identifying traditional predictors of academic success in the BPharm degree programme is between ten and twenty years old and originated in the USA. More recently, research has focused on predictors of academic success in the more clinically focused PharmD or MPharm degrees, as well as identification of non-

traditional predictors of academic performance. The following discussion is inclusive of all three types of pharmacy degrees.

2.5.1 Traditional predictors of academic performance in pharmacy programmes

Much of the early research into the predictors of academic success in pharmacy programmes was focused on pre-admission criteria in order to select students more likely to succeed and graduate in the traditional BPharm degree programme. More recently, research has investigated the usefulness of these predictors for academic performance in the PharmD programmes. The primary predictors that have shown a positive correlation with academic performance in pharmacy programmes in the USA are the Pharmacy College Admission Test (PCAT) and Grade Point Average (GPA) scores and, a prior four year degree.

2.5.1.1 Pharmacy College Admission Test (PCAT) scores

Extensive research has firmly established the predictive value of the PCAT score on academic achievement of first year pharmacy students (Allen & Bond, 2001; Chisholm, Cobb, & Kotzan, 1995; Hardinger, Schauner, Graham, & Garavalia, 2013; Kelley, Secnik, & Boye, 2001; Kidd & Latif, 2003; Meagher, Lin, & Stellato, 2006; Meagher, Pan, & Perez, 2011; Schauner, Hardinger, Graham, & Garavalia, 2013; Thomas & Draugalis, 2002). There are conflicting reports with some studies reporting the PCAT (composite score) and selected sub-scores as predictors of success in professional pharmacy programmes, while other studies have demonstrated a lack of predictive ability of some or all aspects of the PCAT scores on academic success in professional pharmacy programmes. Kuncel, Credé, Thomas, and Klieger (2005) conducted a meta-analysis of the validity of the PCAT and concluded that the PCAT was indeed a valid predictor of performance in pharmacy programmes, and that much of the variation in the published literature appeared to be a result of sampling error. More recent studies again established the predictive nature of the PCAT and its widespread use for this

purpose in pharmacy programmes in USA (Hardinger et al., 2015; Meagher et al., 2011; Schauner et al., 2013).

In the USA, the PCAT score is currently used by an estimated 85% of pharmacy colleges and schools as part of the admission process and some institutions specify a minimum PCAT score between the 30th and 40th percentile (AACP, 2016). The PCAT is a standardised test which takes four hours to complete and measures skills, abilities and aptitudes deemed to be essential for completion of the undergraduate pharmacy programme (Lobb, Wilkin, McCaffrey, Wilson, & Bentley, 2006). It consists of five multiple choice subsets including biology, chemistry, reading comprehension, quantitative ability and verbal ability, and also includes two essay writing sections (AACP, 2016; Frankel et al., 2014).

South Africa does not have a standardised admissions test like the PCAT. Admission into the BPharm programmes offered by the nine universities in South Africa is based on the grades achieved in the National Senior Certificate school-leaving examinations (used to calculate the APS), prerequisite subjects like Mathematics and Physical Science (Chemistry and Physics), as well as institution-specific admission tests such as English literacy and numeracy skills and in some cases, structured interviews. The APS is set by the specific institution and may differ between universities in terms of the subjects considered and the minimum APS score considered for entry into the BPharm programme.

2.5.1.2 Pre-pharmacy grade point average (GPA) scores

The pre-pharmacy GPA scores, particularly in maths and science have been shown to be good predictors of academic success in pharmacy programmes (Allen & Bond, 2001; Chisholm et al., 1995; Crow, Gaebelein, & Patel, 2005; Kidd & Latif, 2003; Meagher et al., 2006; Schauner et al., 2013). However, variations do exist in the results and there are some conflicting findings when looking at the overall PCAT score and sub-scores, and cumulative

pre-pharmacy GPA. The more consistent findings relate to the pre-pharmacy science and maths GPAs and academic success (Houglum, Aparasu, & Delfinis, 2005). All USA colleges and schools of pharmacy require a minimum of two years of prerequisite course material. However, the content is not standardised across the institutions (AACP, 2016).

2.5.1.3 A prior four year bachelor degree

Pharmacy students who have completed a four year bachelor degree prior to entering pharmacy have a greater incidence of success in pharmacy programmes (Chisholm, 2001; Chisholm et al., 1995; McCall et al., 2006; T. L. Myers, DeHart, Vuk, & Bursac, 2013; Renzi, Krzeminski, & Sauberan, 2007; Thomas & Draugalis, 2002). One of the overlooked aspects arising from this finding questions the influence of the underlying characteristics that drive an individual to succeed in academic studies, such as age, motivation or intellectual ability (Oderda et al., 2010).

2.5.2 Additional predictors of academic performance in pharmacy programmes

While the research findings demonstrate that the traditional cognitive test scores (PCAT, GPA) can be used to predict academic success in didactic courses, these scores have not fared as well when predicting success in clinically-focused courses, where the emphasis changes from a knowledge base to application of knowledge for the purpose of problem solving (Chisholm et al., 1995). This observation was highlighted by Latif (2005, p. 723) when he commented that "school grades and aptitude tests are at best, mediocre predictors of healthcare professionals' performance". There is a growing recognition of the multi-factorial complexity of academic achievement in higher education, prompting continued research into the identification of predictors of academic success. This realisation has also led to the recognition of non-traditional and non-cognitive traits which include desirable qualities like responsibility, self-motivation and professionalism. Class sizes, language barriers, cultural diversity and

learning at the secondary level of education have also been suggested as factors which may need to be considered (Hardinger et al., 2015).

2.5.2.1 Measures of cognitive ability or intelligence

Traditional markers of academic ability have shown variations in the usefulness of their predictive ability in pharmacy education (Allen & Bond, 2001; Chisholm et al., 1995; Hardigan, Lai, Arneson, & Robeson, 2001; Kidd & Latif, 2003; Thomas & Draugalis, 2002). However, consensus remains that tests of academic ability such as PCAT or GPA can be used to predict educational outcomes, since there is evidence of a moderate to strong correlation between cognitive ability and academic achievement (Deary, Strand, Smith, & Fernandes, 2007).

Spearman's general intelligence factor (g)

Spearman proposed that there was a general factor underlying mental ability, known as the general intelligence factor or *g* (Spearman, 1904), which was derived from factor analysis of large sets of a multitude of mental tests. Spearman's two factor theory of intelligence proposed two components of *g*, known as eductive and reproductive ability (Raven, Raven, & Court, 1998). Eductive ability is being able to make meaning out of confusion, while reproductive ability is the ability to master, recall and reproduce material which constitutes a culture's store of specific and largely verbal information. The *g* factor is still recognised by experts as the working definition of intelligence as it describes mental aptitude rather than accumulated knowledge. Intelligence can then be described as the ability to deal with cognitive complexity and typically involves reasoning, problem solving, abstract thinking, decision making and other higher order thinking skills (Gottfredson, 1997).

Theories of intelligence further divide *g* into crystallised intelligence (G*c*), which relates to knowledge acquired as a result of past experiences and, fluid intelligence (G*f*), which

is the ability to cope with new situations (Buschkuehl & Jaeggi, 2010). Fluid intelligence is widely regarded as one of the most important factors in learning and has been related to educational and professional success, especially in complex environments. G*f* is considered to be conceptually close to *g* (Gottfredson, 1997). Matrix reasoning tasks such as Raven's Progressive Matrices have been used to measure G*f* (Buschkuehl & Jaeggi, 2010).

Psychometric studies have found that Raven's Progressive Matrices (RPM) which consist of standardised tests of abstract reasoning ability, have the highest loading on the *g* factor of intelligence (Haier, White, & Alkire, 2003; Jensen, 1998). Originally designed as a test to measure eductive ability, RPM is now more widely used as a test of general intelligence since it shows a high correlation with other multi-domain intelligence tests (Raven et al., 1998). Opinions differ as to whether the RPM measures a single set of basic cognitive process (Carpenter et al., 1990) or two processes, analytical based on propositional representation and mental imagery based on visual representation (Lynn, Allik, & Irwing, 2004). DeShon, Chan, and Weissbein (1995) concluded that RPM remains a valid measure of *g*, as it samples from both the visual-spatial and verbal-analytic processes.

The Flynn effect

One of the confounding issues when measuring general intelligence is the "Flynn effect", where intelligence scores, including RPM, in the general population have been shown to increase over time (Brouwers, Van de Vijver, & Van Hemert, 2009; Flynn & Rossi-Casé, 2012; Wongupparaj, Kumari, & Morris, 2015). Various hypotheses for the causes of this effect have been proposed which include environmental factors (like dietary changes, reductions in family size and improvements in education); methodological issues which make inter-study comparisons difficult; genetic effects and even reduced fertility (R. L. Williams, 2013). One of the criticisms of using RPM for measurements of *g* was highlighted by Wicherts, Dolan, Carlson, and van der Maas (2010), who reviewed published data on the use of RPM in sub-

Saharan Africans and found that the test scores appeared to be relatively weak indicators of general intelligence in Africans. The researchers concluded that the lower test scores seen could imply that the Flynn effect had not occurred in sub-Saharan African populations. Wongupparaj et al. (2015) subsequently reported a larger Flynn effect in RPM test scores from developing countries, implying that the gap in scores was closing between developed and developing countries.

The Jensen effect

Differences in RPM test scores have also been reported based on race, notably between white Americans and black African-Americans (Lynn et al., 2004). These lower scores have also been reported in sub-Saharan Africa as mentioned previously (Wicherts et al., 2010). This impact of race and the implied genetic influences on measurements of intelligence is known as the Jensen effect (Rushton, 1998; Rushton & Jensen, 2005) and is important to consider when conducting research in a South African context, where university student populations are characteristically multi-racial with diverse language, educational and cultural backgrounds. The implication is that interpretation of RPM test scores may be more complex than expected.

Raven's Progressive Matrices

RPM are a set of non-verbal intelligence tests, which have been widely used in clinical and educational settings. The Matrices consist of three standardised intelligence test procedures, namely the Coloured Progressive Matrices (CPM), Standard Progressive Matrices (SPM) and Advanced Progressive Matrices (APM) (Raven et al., 1998). The Standard Progressive Matrices was developed for use in the general population and remains the most widely used of the three tests (Wongupparaj et al., 2015).

Although the Raven's Progressive Matrices have been considered by many experts to be a pure indicator of general intelligence (Jensen, 1998), others dispute this claim (Gignac, 2015). Evidence that the Flynn effect is most pronounced on Raven's suggests that it is not as

pure a measure of intelligence as originally suggested. Gignac (2015) argued that it is unlikely that a single test score is able to measure a construct as abstract as general intelligence, but concluded that Raven's remains a good test of *g*.

Raven's SPM is a multiple-choice based test instrument which is used to evaluate mental ability associated with abstract reasoning (higher order thinking). The instrument consists of five sets of 12 tasks involving pattern matching, which increase in difficulty, and does not depend on language abilities. The associated problem solving ability required when matching the patterns was described by Carpenter et al. (1990, p. 32) as "the ability to induce abstract relations, and the ability to dynamically manage large sets of problem solving goals in working memory". Raven's SPM is considered to be a valid nonverbal indicator of general intelligence (*g*) throughout the world (Raven, Raven, & Court, 2000; Wicherts et al., 2010) and is widely accepted as a nonverbal test of problem solving ability.

No evidence was found in the published literature of the use of RPM as a predictor for academic achievement in pharmacy education. However, some research in this area has been conducted in a South African setting. Gender and racial differences in SPM test scores were reported by Rushton and Skuy (2001) in 309 students in two South African universities. Further research with engineering students at University of Witwatersrand again found significant differences between African, Indian and White students in the SPM (Rushton, Skuy, & Fridjhon, 2002) and APM test scores (Rushton, Skuy, & Fridjhon, 2003). Both tests were shown to be predictive of final end-of-year grades, suggesting a definite association between academic achievement and RPM. This was confirmed more recently by Seabi (2011) who administered Ravens APM to 111 engineering students at the University of Witwatersrand in South Africa, and reported a modest but significant correlation between intellectual functioning and academic achievement (measured by end of year examination marks).

Research has also been conducted with first year psychology students at University of Witwatersrand, where an intervention, using a mediated learning experience (based on Feuerstein's model), was shown to improve SPM test scores, with the African students showing a significantly greater improvement (Skuy et al., 2002). However, there was no significant correlation between SPM test scores and academic performance (psychology end- of-year examination marks). Similarly, reasoning ability as measured by Raven's SPM was not found to be a predictor of success in pharmacology in research conducted with second year pharmacy students at the Nelson Mandela Metropolitan University in South Africa (Boschmans, 2013), although a possible limitation identified was the small sample of students involved.

2.5.2.2 Language as a predictor for academic success

English is widely regarded as the universal language of science (Drubin & Kellogg, 2012). In most countries, pharmacy programmes with their strong science-based foundation are presented in English although many of the students may be categorised as "English as a second language (ESL)" students. Below average proficiency in English can then become a major obstacle as reading is fundamental for every academic area (Nel, Dreyer, & Klopper, 2004). Research has shown that a key factor in academic success in tertiary level education is reading ability, yet this is often overlooked. Reading at this level of education not only involves the identification of written words (decoding information) but must include understanding (comprehension) as this is essential for the analysis and evaluation of information. Poor reading comprehension ability can therefore negatively impact on academic performance (Bharuthram, 2012).

Vocabulary knowledge is a known indicator of reading comprehension ability (Zhang & Anual, 2008). Diaz-Gilbert (2004) found that a group of 25 ESL pharmacy students from pre-pharmacy to fourth professional year had significant misunderstandings of essential and

commonly encountered words used in health and the pharmacy environment, which not only impacted negatively on academic success but also on the future quality of professional practice. Low English proficiency has been shown to be a predictor of weak academic performance and slow academic progression in New Zealand (Green, 2015), the United Kingdom (Hassell, Seston, Eden, & Willis, 2007; A. Long et al., 2008; Sharif, Gifford, Morris, & Barber, 2003; Sharif, Gifford, Morris, & Barber, 2007) and Australia (Holder, Jones, Robinson, & Krass, 1999).

Sub-optimal English literacy levels have also been shown to negatively impact on academic progression of students entering South African universities (Bharuthram, 2012). Diab, Flack, Mabuza, and Moolman (2015) found that rural-origin health sciences students struggled with English as the language of teaching and learning at university level, probably as a result of African language use at home and by teachers in primary and many secondary schools in most rural areas of South Africa. Boschmans (2013) reported a significant correlation between English reading comprehension and achievement in pharmacology in undergraduate pharmacy students at NMMU in South Africa.

2.5.2.3 Gender, race and cultural diversity

Gender differences have been investigated as a possible determinant of academic success in pharmacy programme, with varying results. At the University of Manchester, pre-admission test scores found no significant gender differences but academic performance of females in first year of the pharmacy programme was significantly higher in comparison with male students (Sharif et al., 2007). Female pharmacy students in South Dakota, USA were less likely to be put on academic probation due to poor academic performance (Houglum et al., 2005). However, earlier studies found that the influence of gender on academic achievement

appeared to be insignificant or small (Charupatanapong, McCormick, & Rascati, 1994; Kawahara & Ethington, 1994).

Some researchers have investigated the contribution of race or cultural background on academic success. Predictors for academic success in minority students attending Howard University (a historically Black university in USA) were found to be the same to those for non-minority students (Dutta, Wutoh, Williams, & Ofosu, 2002). The role of cultural background and ethnicity has therefore been considered as a possible predictor but co-existing factors such as poor English proficiency and socioeconomic status complicate interpretation of results.

2.5.2.4 Motivation

An emerging factor warranting further investigation is student motivation, and one aspect that has been considered is goal setting as a motivator to improve performance. Latham and Locke's goal efficacy framework was used by Carroll and Garavalia (2004), who measured student ability (PCAT scores, Science/Math GPA), self-efficacy and goal orientation. However, the results did not show a link between goal orientation and academic performance.

Hastings, West, and Hong (2005) investigated changes in pharmacy student motivation during progression through the pharmacy programme, and noted that although the students showed a mastery goal orientation, a shift away from this goal orientation occurred during the programme, mostly during the first professional year. However, although the findings were deemed statistically significant, the authors questioned the educational significance of these results, as overall the students continued to be motivated by a mastery goal orientation.

The achievement goals of pharmacy students from four different countries were investigated in a recent study by Alrakaf et al. (2015) using the Achievement Goal Questionnaire. The results showed that the predominant goal was the mastery-approach, where

the individuals are motivated to learn and improve their skills through understanding the academic activity. This approach is linked to deep learning strategies, a keen interest in the subject and seeking help when needed, so is ideal for creating life-long learners. Results also showed that students using the mastery approach goal were more likely to achieve higher scores in short essay-type assessments that measure understanding and depth of knowledge. However, the researchers found no significant relationship between academic achievement and goal achievement.

Thus results to date have not established a definite relationship between motivation and academic performance, although motivation is considered to influence academic success.

2.5.2.5 Academic skills

Essential academic skills such as time management, academic competence, study strategies and test competence have been shown to be factors that can influence academic performance (Womble, 2003). Sansgiry, Bhosle, and Sail (2006) conducted research with PharmD students at University of Houston and found that test competence (how students cope with the amount of study material for examination) and academic competence (students' ability to manage academic workload) were positively associated with academic performance (measured by cumulative GPA), while test anxiety showed a negative correlation. They recommended remediation interventions be introduced in pharmacy programmes in order to improve academic progression and retention.

In Nigeria, the influence of cognitive factors on academic performance was investigated in seven pharmacy schools and academic performance was found to be negatively affected by test anxiety, while positive associations were found with time management, academic competence and test competence, with female students obtaining significantly better scores for time management and, older students for study habits (Ubaka, Sansgiry, & Ukwe, 2015).

Similar findings were reported in a South African setting by B. Summers and Mpanda (2015), who identified that time management and motivation were key factors for success in a postgraduate Masters level degree programme at the University of Limpopo in South Africa.

Landin and Pérez (2015) investigated class attendance and academic achievement and showed conclusively that regular lecture attendance by the group of European pharmacy students was associated with better academic performance. One of the possible reasons suggested for poor attendance was low student motivation levels.

2.5.2.6 Learning styles

Learning styles have been the subject of numerous research projects and researchers have identified learning styles as a contributing factor to academic success in higher education (Romanelli et al., 2009). Arising from the large number of theories of learning, there are a multitude of definitions of learning styles. A learning style can be defined as "the ways in which individuals characteristically approach different learning tasks" (Cassidy, 2004, p. 421), or "the ways in which a student prefers to take in and process information" (Tsingos, Bosnic-Anticevich, & Smith, 2015, p. 492). According to Peterson, Rayner, and Armstrong (2009, p. 520), more than 40% of learning style researchers surveyed defined learning style as "an individual's preferred ways of responding (cognitively and behaviourally) to learning tasks which change depending on the environment or context".

Curry (1983) used a 3-layer onion model to describe learning styles, using the onion layers as a metaphor for the multiple layers of preference. This model was later updated to include a fourth layer (Curry, 1987). The onion's outer layer illustrates learning style as an *instructional preference (*an aspect the learner has little control over, making this the least stable of the levels); the second layer relates to the learner's preference for *social interaction* during learning, while the third layer represents learning style as the *information-processing*

style (the learner has more control over this level and uses various strategies to process information). The fourth and innermost layer represents the learning style as a *cognitive personality* style (i.e. the individual's underlying approach to thinking) and is seen as the most stable layer.

Much of the on-going academic debate has centred on whether a learning style construct is stable (i.e. a trait, and therefore difficult to change) or adaptive (i.e. a state, and therefore more flexible and capable of change) (Cassidy, 2004). Research has in fact shown that learning styles may change as the learning environment changes (Gurpinar, Bati, & Tetik, 2011). This finding is of particular interest in pharmacy education where one would expect the learning styles of pharmacy students to remain stable during the period of university-based didactic courses, but likely to change when students move to the clinical or practice setting (Tsingos et al., 2015).

A comprehensive systematic review of learning style models, focusing on their validity, reliability and practicality was commissioned by the United Kingdom Learning and Skills Research Centre. The report by Coffield, Moseley, Hall, and Ecclestone (2004) identified more than 70 learning styles models, which the investigators narrowed down to the thirteen most influential learning style models. These were then categorised into five families based on their foundational beliefs and assumptions. Family 1 is constitutionally based; Family 2 is based on cognitive structure; Family 3 is based on a stable personality style; Family 4, on a flexibly stable style and Family 5, on the move towards learning approaches and conceptions of learning (Table 2.1).

Table 2.1
Families of learning styles sourced and adapted from Coffield et al, 2004

Families of Learning Styles				
1. Constitutionally based	**2. Cognitive Structure**	**3. Stable personality style**	**4. Flexibly stable style**	**5. Move to learning approaches & conceptions of learning**
Learning styles and preferences are largely a result of fixed, inherited *traits* , so the learning style should not change. Includes the four modalities of visual, auditory, kinaesthetic	Learning styles reflect deep seated features of the cognitive structure, including "patterns of ability"	Learning styles are one component of a relatively stable personality type	Learning styles are flexibly stable learning *preferences*	Moves away from learning styles, to learning approaches. Personal factors such as motivation, and environmental factors like cooperative learning are considered, as well as effects of curriculum design and teaching and assessment tasks
Examples of Learning Style Instruments within each family				
Dunn and Dunn model and instruments of learning styles	Riding's Cognitive Styles Analysis (CSA)	Apter's Motivational Style Profile (MSP)	Allinson and Hayes' Cognitive Styles Index (CSI)	Entwhistle's Approaches and Study Skills Inventory for Students (ASSIST)
Gregorc's Mind Styles Model and Style Delineator (GSD)		Jackson's Learning Styles Profiler (LSP)	Hermann's Brain Dominance Instrument (HBDI)	Sternberg's Thinking Styles Inventory (TSI)
		Myers-Briggs Indicator Type (MBTI)	Honey and Mumford's Learning Style Questionnaire Kolb's Learning Style	Vermunt's Inventory of Learning Styles (ILS)
(Includes models by Bartlett, Betts, Gordon, Marks, Paivio, Richardson, Sheehan and Torrance)	(Includes models by Broverman, Cooper, Gardner et al, Guilford, Holzman and Klein Hudson, Hunt, Kagan, Kogan, Messick, Pettigrew and Witkin)	(Includes models by Epstein and Meier, Harrison-Branson, and Miller)	(Includes models by Felder and Silverman, Hermanussen, Wierstra, de Jong and Thijssen, Kaufmann, Kirton, McCarthy)	(Includes models by Biggs, Conti and Kolody, Grasha-Reichmann, Hill, Marton and Saljo, McKenney and Keen, Pask, Pintric, Smith, Garcia and McCeachie, Schmeck, Weinstein, Zimmerman and Palmer and Whetton and Cameron)

Although Coffield et al. (2004) cautioned against the use of learning style models and associated instruments by educators due to the inconsistent and highly variable research findings, researchers have argued that an insight into learning styles can be of value both to the student as well as the educators (Felder, 2010; Tsingos et al., 2015).

Three of the thirteen influential learning style models have been used in pharmacy research, namely the Myers-Briggs Type Indicator (MBTI) (I. B. Myers, McCaulley, Quenk, & Hammer, 1985), Vermunt's Inventory of Learning Style (ILS) (Vermunt, 1994), and Kolb's Learning Style Inventory (LSI) (D. Kolb, 1984).

Kolb's Learning Style Inventory

Kolb's LSI has been used in educational research for over 30 years so its use is supported by a significant volume of knowledge (Coffield et al., 2004). The LSI measures learning at the information processing level. Kolb's learning style model was developed from a foundation of psychology, physiology and philosophy, as Kolb believed that an individual's learning style is synthesised from genetic characteristics, past experience and the social environment, and that learning styles are adaptive and thus may change over time (D. Kolb, 1984).

Kolb described four modes of learning which lead to four learning styles. The first learning mode starts with a *concrete experience* (CE), followed by *reflective observation* (RO) which leads to an *abstract conceptualisation* (AC), which is followed by *active experimentation* (AE) (D. Kolb, 1984). Learning can therefore be described as two related modes of grasping experience (CE and AC), and transforming experience (RO and AE). The "*active-reflective*" (AE-RO) axis relates to how perceptions are processed and transformed, while the "*abstract-concrete*" (AC-CE) axis relates to how new experiences and information are perceived (D. Kolb, 1985) (Figure 2.1).

Kolb named the four learning styles as the Diverger (CE and RO), the Assimilator (AC and RO), the Converger (AC and AE) and the Accommodator (CE and AE) (D. Kolb, 1984). The cycle is continuous, and students move from one mode to another, according to their learning needs) (Figure 2.1)

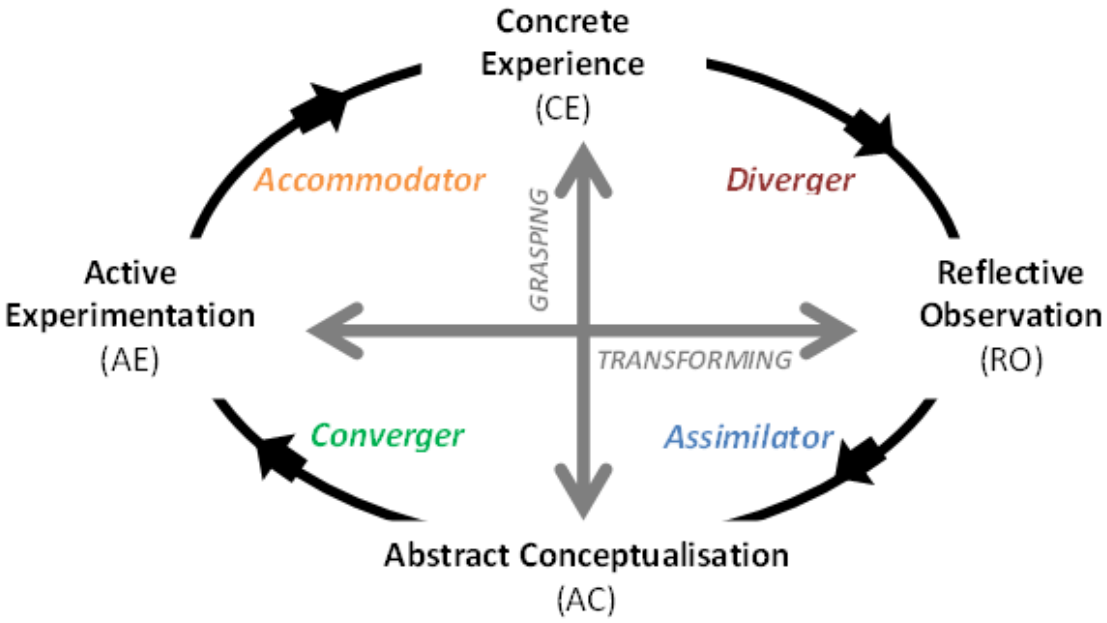


Figure 2.1

Kolb's experiential learning cycle (A. Kolb & Kolb, 2012)

Kolb's Learning Style Inventory is administered as a standardised questionnaire, and through the use of a self-scoring scale allows learners to identify their preferred or dominant learning style, and the associated characteristics (Table 2.2). Educators should be aware of the characteristics associated with the different learning styles during curriculum development, in order to create an effective learning environment for the diverse needs of the students (B. Williams, Brown, & Etherington, 2013).

Use of Kolb's LSI in pharmacy education research

Research into the learning styles of pharmacy students has been complicated by the use of several different learning style models. Kolb's LSI (Table 2.1, Family 4) has been used in

several studies investigating the learning styles of both pharmacy professionals and students (Austin, 2004a).

Table 2.2
Characteristics of Kolb's learning styles

Learning Style	Characteristics
Diverger (CE and RO)	Prefer to view situations from several different perspectives. Prefer observation rather than action. Work well when generating ideas, "brainstorming". Strength lies in their imaginative ability. Interested in people, tend to be imaginative and emotional. Often found in humanities and liberal arts. When learning, prefer to work in groups, listen with an open mind and like personalised feedback.
Assimilator (RO and AC)	Competent at understanding information, and organising into a concise, logical order. Excel in inductive reasoning. Their strength is creating theories, which must be logically sound and precise. Less interested in people, more interested in abstract concepts. Characteristic of students in basic sciences and mathematics. When learning, prefer lectures, reading, exploring analytical models and having time to think things through.
Converger (AC and AE)	Like to apply practical ideas to problems and perform at their best when there is only one answer. Good at deductive reasoning. Enjoy problem solving and decision making. Relatively unemotional, prefer to deal with things rather than people. Often specialise in physical sciences. When learning, prefer to experiment with new ideas, simulations, laboratory assignments and practical applications.
Accommodator (AE and CE)	Enjoy hands-on experiences. Thrive in new and challenging situations. Very effective at getting things done. Tend to be risk-takers. Excel in situations that require adaptation to the specific circumstances. Tend to be at ease with people but may come across as impatient or pushy. Tend to solve problems in an intuitive trial and error manner, and may act on "gut" feel rather than using logical analysis. Often found in technical or practical careers. When learning, prefer to work with others to get assignments done, set goals, conduct field work and try different approaches to completing a project.

Adapted from D. Kolb (1985), B. Williams et al. (2013), A. Kolb and Kolb (2005)
CE = concrete experience: RO = reflective observation; AC = abstract conceptualisation; AE = active experimentation

The earliest study on learning styles in pharmacy students by Garvey (1984) found that pharmacy students *(n* = 501) at the University of Arizona could be categorised as Convergers (50.7%), preferring to learn by thinking and doing, with the rest of the group fairly evenly distributed between Assimilators (19.6%), Accommodators (17.1%) and Divergers (12.6%). The researchers also found a significantly higher GPA in the Converger group. Learning styles have been used to guide curricula development for PharmD programmes (Adamcik, Hurley, &

Erramouspe, 1996), who reported that most of the pharmacy students (n = 40) could be categorised as Convergers, supporting the need for active learning and real-life experiences. Austin (2004b) researched the learning styles of pharmacists and career choices and reported that 33.7% of the 166 respondents were Assimilators, closely followed by Convergers (32.5%), Divergers (21.1%) and Accommodators (12.1%).

Kolb's LSI was used by Pungente, Wasan, and Moffett (2003) in order to identify preferences shown by Canadian first year pharmacy students towards various problem based learning activities. They found that students with a Diverger learning style showed the lowest preference for the PBL approach, while the Convergers demonstrated a strong preference, and the Assimilators and Accommodators also exhibited positive responses to problem based learning (PBL) activities. In contrast with the previous studies, the results involving 116 students showed a relatively even distribution across the learning styles, with just over a third of the group categorised as Accommodators (36.2%), and the rest were evenly distributed into Convergers (22.4%), Divergers (21.6%) and Assimilators (19.8%).

Learning styles in pharmacy education research

Research has also demonstrated that learning styles may change over time, and on exposure to new teaching approaches such as problem based learning (Novak, Sonalee, Wilson, Lawson, & Salzman, 2006). Novak et al. (2006) found significant changes in learning styles of second year pharmacy students after a semester-long PBL course, measured with the Grasha-Reichmann Student Learning Scale (Table 2.1, Family 5). One of the variables mentioned as a reason for the change was stress experienced by students, familiar and comfortable with traditional didactic teaching, who then had to adapt to a new teaching approach and the resultant time required for the adapation. Gurpinar, Alimoglu, Mamakli, and Aktekin (2010) found that medical students showed significantly stronger satisfaction scores with PBL compared to traditional teaching methods, but did not find a link between PBL satisfaction and academic

success. They noted that Assimilators may predict satisfaction with traditional teaching methods and academic achievement, but in contrast to studies with pharmacy students, the majority of medical students were grouped as Divergers (47.7%) and Assimilators (41.5%), with only 6.3% as Convergers.

Research into personality types and learning styles of 1313 pharmacy students over a ten year period, using the MBTI (Table 2.1, Family 3) identified that the majority of pharmacy students preferred sensing (concrete, step by step progression) and judging (task and result-orientated) preferences, traits that are well suited to more traditional modes of course presentation. The underlying implication is that a move to a more independent, active, experiential type learning could be difficult for some students (Shuck & Phillips, 1999). In South Africa, Rothmann, Basson, and Rothmann (2000) used MBTI in their evaluation of 603 undergraduate pharmacy students, and found the majority preferred sensing and judgement approaches to learning. Lower academic performance and slower academic progression through the course was associated with preferences for extraversion and perception. A later study by Eksteen and Basson (2015) found that the study population of undergraduate pharmacy students at a South African university favoured the Sensing-Feeling preferences, demonstrating a focus on detail and facts.

Moving away from research conducted in Canada and America, L Smith, Krass, Sainsbury, and Rose (2010) used Vermunt's ILS (Table 2.1, Family 5) to conduct a longitudinal investigation into pharmacy students' approaches to learning at the University of Sydney, Australia. Pharmacy students in the BPharm degree (n = 201) and MPharm degree (n = 28) programmes participated. The results showed a decline in deep learning approaches over the undergraduate pharmacy programme, but this reversed back to the initial levels towards the end of the four-year BPharm degree programme, so that there was a change from the initial preference for reproduction-directed methods in first year, to meaning-directed and

application-directed learning approaches in the final year. The strong preference for application-directed learning was considered to be significant as this finding implies that students believed that learning should be associated with use rather than acquisition of knowledge, in line with the practical nature of the profession of pharmacy.

More recently, B. Williams et al. (2013) investigated learning style preferences of 240 undergraduate pharmacy students enrolled in the BPharm programme at Monash University, Victoria, Australia, using Kolb's LSI, Felder and Solomon's Index of Learning Styles (Table 2.1, Family 4) and the Success Types Learning Style Type Indicator (derived from MBTI, Table 2.1, Family 3). Interestingly, results from Kolb's LSI showed that 38.3% were Convergers, with an even distribution of between Assimilator (23.8%) and Accommodator (22.1%), and the smallest group were Divergers (15.8%). These findings are similar to those of Austin (2004b) and Garvey (1984), demonstrating a dominance of Convergers and Assimilators in different populations of pharmacy students. Crawford, Alhreish, and Popovich (2012) also identified dominant learning styles in 299 pharmacy students at the University of Illinois, Chicago, as Assimilator (47%) and Converger (30%), using the Pharmacists' Inventory of Learning Styles (PILS), developed by Austin (2004a) as the first pharmacy-specific instrument (based on Kolb's LSI).

Do learning styles impact on academic performance?

Sharif, Gifford, Morris, and Barber (2010) used the Honey and Mumford Learning Styles Questionnaire (Table 2.1, Family 4) to investigate academic performance, attendance and learning styles of first year pharmacy students at the University of Manchester, and reported a dominant style of Reflectors (tend to be cautious and adopt a low profile), with the least common group being the Activists (tend to act first and then consider the consequences later). The Activists group was also found to have on average, poor attendance records, less independent study time and lower first year examination results. They drew a comparison

between Activist group using the Honey and Mumford Learning Styles Questionnaire and the Accommodator group on Kolb's LSI.

Learning styles in pharmacy education in Africa

Little research has been done on learning styles by pharmacy educators in South Africa. Earlier research at NMMU by Boschmans (2013) administered Kolb's LSI to pharmacology students and identified Assimilator as the predominant learning style in Pharmacology2 (51.75%) and Pharmacology3 students (60.38%), while Pharmacology4 students showed an equal distribution between Assimilator (35.90%) and Converger (35.90%) learning styles. The relationship between learning styles and academic achievement was not investigated.

Paiva and Wilby (2015) evaluated the validity and reliability of PILS (Austin, 2004a) in Ghana. Nine hospital pharmacy staff participated, two pharmacists, three pharmacy technicians and four staff with no healthcare training. Both pharmacists scored as assimilators. The validity and reliability of the instrument could not be established for several reasons, and a major limitation was the small sample size. Of concern was the cultural avoidance of questions to seek clarification of meaning of terms and use of culturally unfamiliar vocabulary in the instrument, as well as a lack of exposure of this population to teaching methods other than traditional lecture-based sessions.

The influence of cultural background on learning styles was explored by Joy and Kolb (2009), who found that culture did have an impact on learning style scores (using Kolb LSI), comparable to some of the demographic variables such as age. Culture had a significant effect on an individual's preference for abstract conceptualisation versus concrete experience, but only a marginally significant effect on preferences for active experimentation and reflective observation. These findings suggest that learning styles of pharmacy students and their associated academic performance may be influenced by different cultural beliefs and

backgrounds, and this impact may become a significant factor with the increasing internationalisation of education, bringing cultural diversity to the learning environments. This is of particular relevance in South Africa, which is characterised by a rich cultural and ethnic diversity, as illustrated by its eleven official languages.

Thus in summary, there are numerous reports of research into the learning styles of pharmacy students. The influence of learning styles on academic achievement in experiential learning environments warrants further investigation, based on evidence that the need to adopt a different learning approach may cause difficulties for some types of learners.

2.5.2.7 Pharmacy work experience

One of the potential factors identified as a possible predictor of academic success in pharmacy programmes is experiential learning, in the form of pharmacy work-related experience. The assumption is that if students participated in part-time employment in pharmacy-related settings, classroom learning could be enhanced. Surprisingly, Mar et al. (2010) did not find a relationship between work experience in a pharmacy prior to entering the pharmacy programme and academic or clinical performance, although several limitations to the research were identified. Valdez, Namdar, and Valuck (2013) subsequently investigated total work experience in a pharmacy, average hours worked per week during pharmacy school, as well as work experience prior to pharmacy school and concluded that any pharmacy-related work experience showed a positive correlation to knowledge retention, which would positively impact on academic performance. The researchers further noted that at the University of Colorado where the research was conducted, students lacking pharmacy work experience were the students most commonly experiencing academic delays and academic difficulties. In the USA, an online survey of pharmacy students attending the University of Buffalo found that a moderate amount of part time employment (< 14 hours per week) was deemed beneficial for

academic performance, although students working 15 to 19 hours per week were found to have significantly lower GPA ($p < .05$) (Ho, Chan, Fan-Harvard, Thompson, & Hess, 2014).

2.5.2.8 Predictors of academic success in the South African context

Research into predictors of academic success in South Africa's pharmacy programmes needs to be viewed in the broader context of the challenges facing higher education in the post-apartheid era. In this setting, academic performance, not only in pharmacy programmes, has been shown to be further influenced by social class and race, with students from a middle class family and school background better prepared for the transition from school to university. In contrast, first generation students entering university from a working class family background are ill prepared, with a lack of support, both from families with no experience of higher education and also from schools which are overcrowded and under-resourced and often lacking in skilled and knowledgeable teachers (McMillan, 2007). Research with second year dentistry students found that while social class and race played a role, internal factors such as assumptions of controllability over their environment also played a contribution to academic performance (McMillan, 2015).

2.5.2.9 Summary

As presented in this section, numerous factors have been identified which can influence academic success in pharmacy programmes, although research has produced variable and conflicting results. For this reason, many universities now utilise a combination of student interviews, traditional admission tests (PCAT and GPA scores; pre-pharmacy mathematics and science scores; reading comprehension scores) and non-traditional assessments (structured interviews and essay writing) in order to select the students most likely to succeed.

2.6 EXPERIENTIAL LEARNING AND THE CLINICAL ENVIRONMENT

Experiential learning in pharmacy education is now recognised and widely accepted as a vital and necessary component of undergraduate training. Experiential learning in the professional practice environment is seated in the "situated learning" theory (Chapter Two, Section 2.4), as the pharmacy students become novice members of a community of practice and their participation and active engagement with this community further develops their professional identity. This move from didactic-based coursework to experiential placements must be accompanied by the transfer of textbook knowledge gained in the lecture-based setting to active, real-life learning experiences with a focus on patient care (Frankel et al., 2014). This contextual transfer of knowledge then encourages application of knowledge and critical thinking in order to solve real-life problems (Brackett & Reuning, 1999).

2.6.1 Application of knowledge and problem solving

The link between learning and application of knowledge and critical thinking has been the focus of much research in recent years. Bloom's taxonomy of educational objectives (1956) identified three domains of learning, namely cognitive (knowledge), affective (attitudes) and psychomotor (skills). The cognitive domain deals with recall or recognition of knowledge and the development of intellectual abilities and skills. The six-tier hierarchical structure starts with *Knowledge* at the lowest level, which involves acquisition, recognition or recall of information (Figure 2.2). This lowest level is the simplest learning process and typically involves rote-learning, while the highest levels of *Synthesis* and *Evaluation* require complex higher order thinking processes. *Application* of knowledge is situated at the third level and requires administering a concept or acquired knowledge in a new situation, or abstract conceptualisation to solve problems. The higher levels of *Analysis*, *Synthesis* and *Evaluation* involve linking multiple factors when problem solving, with increasing complexity at each stage.

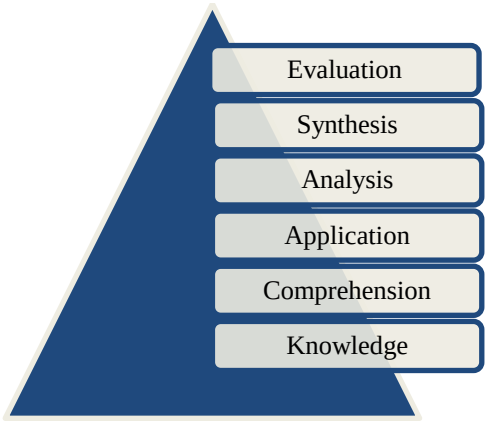


Figure 2.2

Bloom's six-tier taxonomy of learning (Bloom, 1956)

In 2001, Bloom's taxonomy for the cognitive domain was revised and one modification was the use of verbs rather than nouns for each level of the list. Secondly, the last two levels were swopped around in terms of their order, namely *Synthesis* became *Evaluate* and *Evaluation* was renamed *Create* (L. Anderson & Krathwohl, 2001; Krathwohl, 2002). Lastly, the types of knowledge were separated from the cognitive processes used.

The cognitive domain was therefore split into two categories, namely the Cognitive Process domain (remember, understand, apply, analyse, evaluate and create), and the Knowledge domain (factual, conceptual, procedural and metacognitive knowledge). The revised taxonomy could be tabulated with Cognitive Process on the horizontal axis and Knowledge on the vertical axis. Application of knowledge remained at the third level of learning and the revised model was seen as less hierarchical, enabling overlap in many of the categories (Figure 2.3).

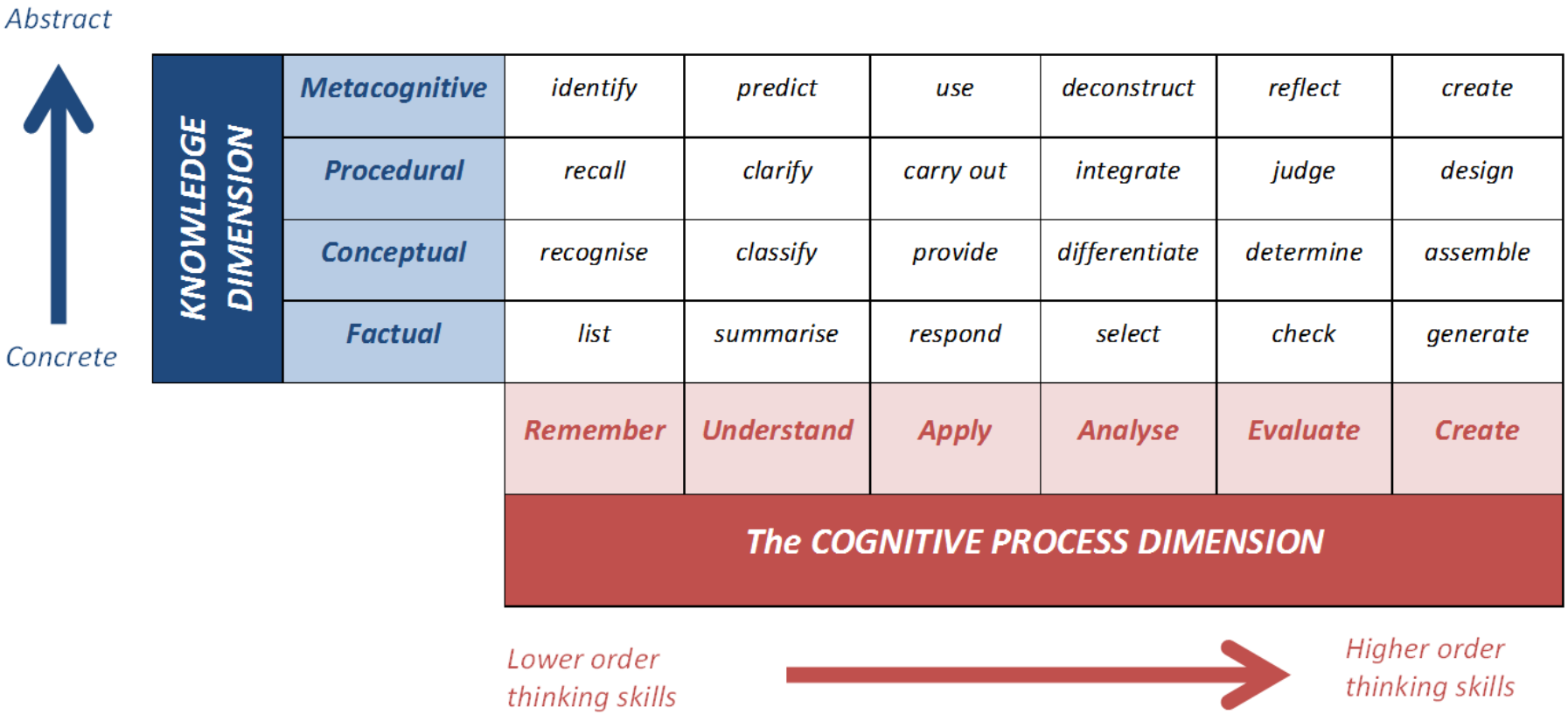


Figure 2.3

Anderson and Krathwohl's (2001) revision of Bloom's taxonomy of learning objectives showing intersection of Cognitive Process Dimension and the Knowledge Dimension *(with examples of verbs to illustrate the intended cognitive process, adapted from Heer's model (2012)).*

Pharmacy educators have been tasked by the profession and society as a whole, to produce high quality pharmacy graduates who are able to apply their knowledge for the purpose of problem solving and, possess good critical thinking skills. Beyer (1987) described three essential components for critical thinking to occur, namely domain knowledge, attitude and cognitive abilities. The domain or discipline-specific knowledge is acquired through studying, for example the topic of pharmacology. Attitudes deemed to be important for critical thinking include respect for evidence, health scepticism, curiosity, and, the desire or motivation to solve a problem. Lastly, cognitive or thinking functions require conceptualising, problem solving and decision making, all of which are supported by critical thinking skills (Beyer, 1987).

The need for the attributes of critical thinking and problem solving have been closely scrutinised by medical educators, where assessment of these attributes ultimately drives the changes desired in clinical practice. In 1990, George Miller proposed a framework for assessing clinical competence of medical students (Figure 2.4) which differentiated between "action" (what happens in professional practice) and the lower levels of knowledge, competence, and performance (typically assessed in artificial testing situations such as student assessments) (Miller, 1990).

The ultimate educational outcome of pharmacy programmes is the graduation of a competent pharmacist, who is fit for practice. Thus the move of student learning from the classroom into practice should involve action through active participation and direct but supervised involvement in patient care. The learning value of "action" cannot be over-emphasised. While simulated environments and patient cases have value during preparation for clinical placements, there are skills that cannot be taught, like prioritising tasks during busy periods in a community or hospital pharmacy, or dealing with frustrated or angry patients or healthcare professionals (Pham, 2009). Observing an experienced pharmacist cope with difficult situations or interacting with other healthcare professionals or patients, ideally should

trigger self-reflection of the student's own actions and approach, so that learning is enhanced through a deeper understanding. Thus, experiential learning in the clinical setting typically involves problem solving and requires the application of knowledge. The higher order cognitive functions required to analyse, synthesise and evaluate information then develop as clinical expertise develops with experience.

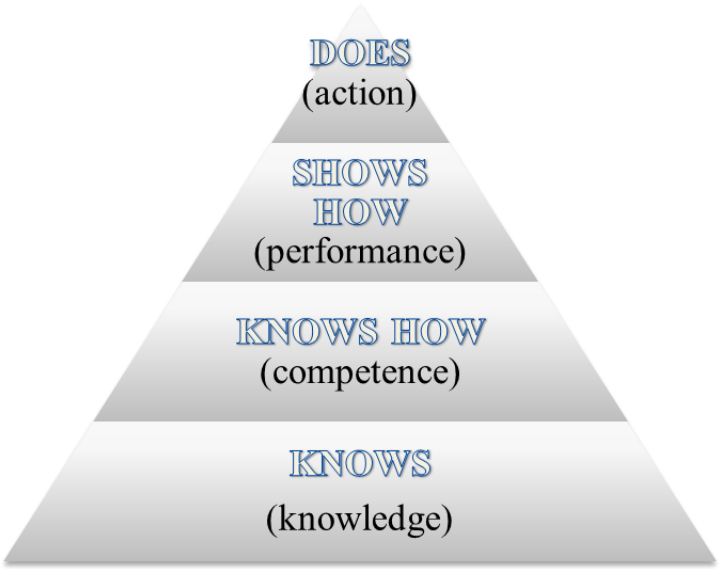


Figure 2.4
Miller's framework for clinical assessment (Miller, 1990, p. S63)

For the purposes of the current research, the processes of apply, analyse, evaluate and create were considered to be higher order thinking and, higher order thinking and critical thinking were considered to be similar cognitive processes.

2.6.2 Problem solving and critical thinking skills

The debate continues about the relationship between critical thinking and problem solving ability. Some feel that critical thinking is inclusive of problem solving, which is the stance taken for this research project. Others suggest that identifying the problem and finding a solution leads to critical thinking. Problem solving has even been suggested to occur in the absence of critical thinking (Oderda et al., 2010). As seen in Bloom's taxonomy, the third level

of the six tiers involves the application of knowledge for the purpose of problem solving (L. Anderson & Krathwohl, 2001; Bloom, 1956). The professional practice of pharmacists involves problem solving and decision making, both of which require higher order thinking skills and, therefore, development of these skills has been identified as a goal of pharmacy education. This goal has also been confirmed by stakeholders in the pharmacy profession, who identified problem solving and critical thinking skills to be among the five top attributes that a newly qualified pharmacist should have (Oderda et al., 2010; D. Thompson, Nuffer, & Brown, 2012).

2.6.2.1 Measures of problem solving and critical thinking

Two of the three most widely used measures of critical thinking have been used in pharmacy education research. The most commonly reported test instrument is the California Critical Thinking Skills Test (CCTST), often used in conjunction with the California Critical Thinking Dispositions Inventory (CCTDI) (Facione, Facione, & Sanchez, 1994), while the second test instrument is the Watson Glaser Critical Thinking Appraisal (WGCTA) (Watson & Glaser, 1980). While the current research project did not include one of these measures of critical thinking since Raven's SPM was utilised as a measure of problem solving ability, it is relevant at this point to consider research into critical thinking skills as a possible predictor of academic success in pharmacy programmes.

2.6.2.2 Critical thinking as a predictor of academic performance

One of the earlier studies on cognitive skills and learning styles of pharmacy students by Adamcik et al. (1996) found that WGCTA scores showed a significant correlation with pre-pharmacy GPA scores, but academic success in the pharmacy programme was not investigated. Cisneros (2009) used CCTST and CCTDI to evaluate critical thinking in pharmacy students from first to fourth year, and noted that the scores on both instruments showed no major

improvement across one academic year. However, there was a correlation between CCTST and PCAT, implying that some elements of critical thinking are measured by the PCAT instrument. There was also a correlation between final GPA scores in fourth year and CCTDI total scores, confirming the link between higher order thinking skills and academic achievement.

As critical thinking is required in the professional practice environment, researchers have also questioned if good critical thinking skills could be a predictor for achievement in the clinical setting. Kidd and Latif (2003) found that only CCTST (and not PCAT) was a predictor of academic performance in APPE's in the clerkship (fourth) year of the PharmD programme, while CCTDI was shown to be a moderate predictor of academic success in coursework during the first three years of the PharmD programme. However, Lobb et al. (2006) found no correlation with first year academic performance in PharmD students using the WGCTA as a measure of critical thinking, and suggested that the WGCTA did not appear to assess abilities directly related to academic performance.

Both CCTST and PCAT were found to be good predictors of academic success in the registration (licensing) examinations like the North American Pharmacist Licensure Examination (NAPLEX) (Allen & Bond, 2001; Kuncel et al., 2005), which by the nature and timing of the examination, could be considered to be a reflection of success in professional practice.

Thus while pharmacy educators remain interested in the development of critical thinking and problem solving skills during the pharmacy curriculum, the use of measuring instruments like CCTST or WGCTA have not been widely adopted as a means to predict academic performance.

2.6.3 Experiential learning in the clinical setting

The application of pharmaceutical knowledge, critical thinking for problem solving purposes, clinical reasoning and decision making are all regarded as fundamental for the provision of pharmaceutical care in the pharmacy practice setting (Chalmers et al., 1995; Frankel et al., 2014; Oderda et al., 2010). The American College of Clinical Pharmacy identified clinical problem solving, judgment and decision making to be a key competency for clinical practice, using the following description of the processes involved:

> Clinical problem solving and decision making are the processes by which patient-specific data are collected, interpreted and analysed; medical problems are assessed: current drug therapy is evaluated; and therapeutic plans are developed.
>
> (Burke et al., 2008, p. 809)

These skills therefore need to be developed during undergraduate pharmacy education using a scaffolding approach with increasing complexity as student knowledge and skills increase with time and academic progression (Patel, Yoskowitz, & Arocha, 2009). Clinical reasoning and decision making and critical thinking skills are best developed through active learning experiences (Peeters, 2011; Rosenthal, Austin, & Tsuyuki, 2010), and a fundamental requirement for successful problem solving and decision making in the clinical setting is a sound comprehensive knowledge base (Kassirer, 2010).

The cognitive processes involved in reasoning or decision making are complex, and can be explained by information processing theory, specifically script theory and dual process theory. In medical education, extensive research has been conducted into clinical reasoning, which is considered to include both diagnostic and therapeutic reasoning processes (Durning, Artino, Schuwirth, & van der Vleuten, 2013). Clinical reasoning has been defined as “the

process of thinking critically about the diagnosis and patient management" (Bissessur et al., 2009, p. 985), although most of the research has focused on the process of diagnostic reasoning.

Research into diagnostic reasoning supports the script theory of information processing (Schank, 1977) in that medical doctors, on encountering a patient with specific signs and symptoms, retrieve "illness scripts" from memory, which provide detailed information about diseases, consequences, context and past experience with similar patients. Repetition of exposure to patient cases reinforces the development of illness scripts (Charlin, Tardif, & Boshuizen, 2000).

The dual process theory of information processing (Norman, 2005b) then determines whether the script is appropriate for the specific patient, using analytical and non-analytical reasoning (or pattern recognition). The analytical component tends to be a slower, more deliberate process that consciously considers alternatives, and is evidence based, following acquired critical and logical thinking patterns. The intuitive process tends to be instinctive and relies on first impressions, quick pattern recognition and rapid responses to information, requiring little active thought, and can be prone to error. Experience plays a large role in intuitive reasoning (Croskerry, 2009; Kassirer, 2010).

The same reasoning process is thought to occur in therapeutic reasoning, which is the step in clinical reasoning that pertains to the choice of therapy. "Treatment scripts" are stored and later retrieved for processing through analytical or non-analytical reasoning. Repetition of the therapeutic problem solving process through repeated exposure to patient case analyses, then "encourages the formation of organised knowledge in the brain, so that frequent exposure to patients and pharmacotherapeutic problems gradually condenses these networks of knowledge into readily accessible therapeutic scripts" (Richir, Tichelaar, Geijteman, & de

Vries, 2008, p. 221). Immediate feedback is crucial in order to consolidate the learning and ensure the correct therapeutic scripts are stored for future retrieval.

Research has shown that pharmacists by nature prefer analytical thinking, demonstrating strengths in logical, analytical and structured thinking, with few using intuitive approaches to decision making (Adamcik et al., 1996; McLaughlin, Cox, Williams, & Shepherd, 2014; Rosenthal et al., 2010). This characteristic can be problematic in the clinical setting, as clinical decision making often requires a less structured approach, based on hunches and recognition of trends or patterns (Kassirer, 2010). Traditional pharmacy education with its strong base in science has emphasised details and factual knowledge rather than application of knowledge, producing pharmacists who may be uncomfortable with immediate intuitive decision making (Rosenthal et al., 2010). Viewed in this context, the move towards increased experiential learning in undergraduate pharmacy programmes may result in students experiencing difficulty when adapting to new approaches to learning and problem solving in the clinical environment.

2.6.3.1 How well does experiential learning in pharmacy education live up to expectations?

Dewey's educational philosophy includes an important observation, namely "the belief that all genuine education comes about through experience, does not mean that all experiences are genuinely educative … for some, experiences are mis-educative" (A. Kolb & Kolb, 2005, p. 205). When considering experiential learning in clinical placements, each pharmacy student's experience will be different, influenced by the site, the preceptor's knowledge and skills, as well as the context in which the learning occurs. Learning is, therefore, directly linked to personal experience and subsequent reflection will lead to a deeper understanding.

Difficulty in the application of knowledge for problem solving and clinical decision making in the patient care environment has been reported by pharmacy, medical, nursing,

occupational health and other students in the health sciences (Blouin et al., 2008; Macpherson & Owen, 2010; Profetto-McGrath, 2003; L Smith et al., 2010). Coupled with this, students may be overwhelmed in the unfamiliar environment which in turn can impair learning. Undergraduate pharmacy students in experiential placements often find that learning "just happens" in an unstructured and uncontrolled environment (Stupans & Owen, 2009). Without a structure, learning may not necessarily happen as planned. Critics of unstructured or minimally guided instructional techniques such as problem-based learning or experiential learning have argued that a structured and planned approach to experiential learning is essential, with good guidance being fundamental for effective learning to occur (Kirschner, Sweller, & Clark, 2006). On the other hand, over-structured experiential placements can also be problematic, with students becoming fixated on completing tasks, rather than building relationships and actively participating in patient care (Owen & Stupans, 2009). It therefore becomes important to look more closely at experiential learning programmes, not only for the benefits but in order to identify areas for improvement.

ELP's, from the student perspective

Research has consistently shown that undergraduate pharmacy students value the opportunity to apply and use clinical knowledge and skills in a "real life" setting, through interaction with real patients in both hospital and community pharmacy settings (Abbas, Burrow, & Rudokas, 2013; Diack, Gibson, Munro, & Strath, 2014; Fejzic, Henderson, Smith, & Mey, 2013; Owen & Stupans, 2009; Shah, 2004; Ting et al., 2009). Sansom and Cox (2013), two third year PharmD students in USA, expressed concern over the Accreditation Council for Pharmaceutical Education's amended policy (approved June 2010) allowing pharmacy education institutions to replace up to 20% of IPPE experiences with simulated activities (ACPE, 2010). While the two students acknowledged the value of simulated experiences, they strongly emphasised that their real-world encounters with patients had developed their

confidence and professional identity. This is consistent with other research in the UK and USA that WIL or practice placements enhance student confidence (Nuffer, Gilliam, McDermott, & Turner, 2015; Pham, 2009; Purdie, Ward, McAdie, King, & Drysdale, 2013). Chase (2007) also stressed the importance of active participation by pharmacy students during pharmacy practice experiences, highlighting the need for students to be involved in improving patient care, rather than their delegation to an observation role. This viewpoint was supported by the American College of Clinical Pharmacy's commentary which outlined the many benefits of student involvement in direct patient care, rather than students being on-site in an observational capacity (Rathbun et al., 2012). Yet IPPE students have still been reported to be spending the majority of their time in observational mode, shadowing pharmacy personnel (Denetclaw, Young, Tiemeier, Scott, & Hartzler, 2014).

An unexpected finding has been reports of students' perceptions of unpreparedness (Abbas et al., 2013; Ackman & Mysak, 2009; Nation & Rutter, 2011). Some preceptors seem to be in agreement, citing students as unprepared and lacking in knowledge, which then limited student participation in direct provision of patient care (Denetclaw et al., 2014). There was also a student perception that the preceptors did not appear to know what the placements involved, suggesting a lack of structure and planning (Owen & Stupans, 2009). Students have also expressed a desire for more commitment and support from the preceptors (Abbas et al., 2013; Ackman & Mysak, 2009; Nation & Rutter, 2011; Shah, 2004).

Physician interaction was perceived as a barrier to provision of patient centred care by Malaysian pharmacy students, who felt least prepared for communication with physicians on commencement of hospital-based placements (Hasan et al., 2013). However, significant post-placement improvements in communication skills were reported after interacting with medical professionals and patients. This perceived dominance of medical doctors in the hierarchical structure of healthcare has previously been reported by UK community pharmacists as a barrier

(Hughes & McCann, 2003), and can limit pharmacist involvement as well as students (Rosenthal et al., 2010).

Not all students respond positively to clinical placements, and one of the reasons, suggested by Shah (2004), was language barriers experienced by the ESL students in the UK. Language can also be a barrier for the students when involved in direct patient care. Fourth year pharmacy students from Midwestern University Chicago College of Pharmacy identified that caring for patients with limited English proficiency was the most commonly encountered cultural event during APPEs (Cooper, Vellurattil, & Quinones-Boex, 2014). A negative attitude towards clinical placements could also be due to a lack of interest in hospital pharmacy as a career option (Shah, 2004).

Australian pharmacy students identified that at some sites, they felt overwhelmed by long lists of tasks to be completed, often in a limited time-frame, which detracted from their learning experience (Owen & Stupans, 2009). As discussed earlier, reflection is an important part of experiential learning, but many students highlighted a need for more preparation and guidance for reflective activities, complaining that reflective diaries became merely a time-consuming log of daily activities, with limited usefulness. Assessment was also raised by students as an issue needing attention in the comprehensive review of Australian pharmacy programme experiential placements by Owen and Stupans (2009), with students requesting transparency of the assessment and immediate feedback.

The optimal duration of clinical placements has been debated frequently by pharmacy educators. Students often expressed a desire for more placements of longer duration (Ackman & Mysak, 2009), yet the logistical requirements and capacity at the practice sites, as well as time away from campus are often cited as limitations, as well as costs. Students also highlighted a need for an earlier implementation for clinical placements in the curriculum, as

the time spent in the hospital environment was felt to be inadequate in terms of achieving learning outcomes (Abbas et al., 2013). In contrast, Ting et al. (2009) reported that a longer duration of placements (41±23 days) for first year pharmacy students in Malaysia did not contribute to a more positive learning experience and concluded that shorter placements (21±16 days) were easier to schedule into the university curriculum. Third year MPharm students from Robert Gordon University completed a week long community pharmacy placement opportunity, and highlighted the experience as positive, recognising the opportunity for contextual transfer of their academic knowledge to the pharmacy practice environment (Diack et al., 2014). Unexpectedly, final year PharmD students unanimously preferred two five-week APPE rotations in two different community pharmacies, compared to a continuous 10 week rotation (Lisa Smith, Greene, Meade, & Spencer, 2009). These conflicting opinions and findings suggest that further investigation is warranted for the optimal duration of placements.

ELP's, from the preceptor's perspective

Professional practitioners play a key role in pharmacy education, as the academic institutions rely heavily on the expertise of pharmacists in practice, as well as their goodwill, with preceptorship in most cases, occurring on a voluntary basis. In the USA, preceptors contribute to 30% of the pharmacy programme through experiential learning placements (Haase et al., 2008), which consist of IPPEs (5%) and APPEs (25%). Thus the need for preceptor training and development was emphasised by the American Association of Colleges of Pharmacy as a key component of quality experiential education (Haase et al., 2008). The crucial role of the placement supervisors or preceptor in this setting was highlighted as a key contributor in reducing "transition shock" in novice students entering the practice environment (Diack et al., 2014).

The majority of preceptors identified that their involvement with pharmacy students provided personal and professional satisfaction, explaining that pharmacy students brought

new energy and enthusiasm as well as knowledge to the practice setting (Chaar et al., 2011; Denetclaw et al., 2014; Wuller & Luer, 2008). A need to "give back" to the profession is often identified as the driver for volunteering to supervise student placement activities. Preceptors tend to take their role and responsibilities seriously, spending both time and effort to ensure that they were well prepared for students (Fejzic et al., 2013).

Problems highlighted by preceptors were increased workload, lack of physical space in the pharmacy to accommodate students, time constraints and increased stress levels (Chaar et al., 2011; Denetclaw et al., 2014; Fejzic et al., 2013; K. Hall et al., 2012; Kirschbaum, Khalil, & Page, 2016; Skrabal et al., 2006). Student assessment was seen as the most challenging component of preceptorship, with many pharmacists expressing a feeling of inadequacy and being unqualified to conduct assessments. Clear, explicit instructions need to be made available so that preceptors understand the students' level of knowledge and skills (Abbas et al., 2013; Wuller & Luer, 2008). Some university-based support mechanisms have been suggested or implemented such as access to university resources (electronic databases), renumeration, increased preceptor training and development or acknowledgement of the preceptor's commitment through awards or certificates (Boyle, Morgan, Layson-Wolf, & De Bittner, 2009; Fejzic et al., 2013; Marriott et al., 2005).

One of the concerns raised by preceptors at practice sites has been professionalism, with preceptors reporting unprofessional behaviour by students during IPPEs and APPEs (Boyle, Beardsley, Morgan, & Rodriguez de Bittner, 2007). Issues that have been raised include punctuality, communication at the practice sites, appropriate attire, active participation and showing initiative, commitment and work ethic. This has led to the development of explicit and detailed guidelines for students and standardised assessment tools for preceptors to utilise during student evaluations. The culture of professionalism is then reinforced by preceptors as

the role models for professional behaviour in the practice sites and pharmacy faculty members at the university level (Boyle et al., 2007; Hammer, 2006; Jackson, 2015).

Experiential learning programmes also have an impact on the practice site itself. Mersfelder and Bouthillier (2012) conducted a literature review in order to determine evidence of the value of the pharmacy students to experiential practice sites in the USA. Students, on average, were responsible for 1.2 to 16 recommendations to prescribers per week (each student on average, formulated 6 recommendations per week). Acceptance rates ranged from 32% to 98%. Studies that evaluated the economic impact reported cost savings or cost avoidance as a result of the student involvement. Other activities included participation in intravenous-to-oral programmes, warfarin dose adjustments, and taking medication histories and medication reconciliations. By all accounts, students were seen to have a positive impact on the practice sites, although the authors suggested that publication bias may have contributed to this finding, as negative outcomes are seldom reported. More recently, a survey of 79 prescribers from four major medical centres in Massachusetts, found a positive perception of the contribution of students, with 61% of providers identifying that involvement of pharmacy students on internal medicine teams was beneficial (Lancaster et al., 2013).

ELP's, from the perspective of pharmacy academic staff

While the need for increased experiential education has not been questioned and is unanimously supported in principle, the increased experiential hours coupled with increased number of students in the context of limited practice sites has been cause for concern. Ongoing difficulties have been experienced by pharmacy educational institutions in the recruitment and retention of suitably qualified professional pharmacy mentors as preceptors for experiential programmes (Danielson, Craddick, Eccles, Kwasnik, & O'Sullivan, 2015; Devine & Darbishire, 2015; Diack et al., 2014; Owen & Stupans, 2009).

A survey of experiential education directors at the accredited pharmacy schools in the USA in 2011, identified the following issues facing experiential learning programmes: site capacity (the most pressing problem); increased workload both at the university level and the practice site and, associated needs for financial support; quality assurance; preceptor stipends; assessment; student orientation at the practice sites; and support and recognition from administration (Danielson et al., 2015). Preceptor recruitment, development and training and retention were also highlighted, in view of the new accreditation guidelines which recommended ratios of student to preceptor of 3:1 for IPPEs and 2:1 for APPEs (ACPE, 2015). Competition with other educational institutions for practice sites was also identified to be problematic, and the overabundance of community pharmacy practice sites and relative lack of other sites like ambulatory care compound the problem (Danielson et al., 2014). The challenges faced in finding institutional sites have resulted in IPPEs now including more simulations, immunisation experience, medication therapy management services and written assignments, over community and hospital sites (Devine & Darbishire, 2015). Some of these changes have been questioned as to whether simulations will adequately prepare students for APPEs. Programmes also reported understaffing, difficulty in conducting site visits and increased administrative loads. The issues raised in the USA are very similar to those identified in Australia (Owen & Stupans, 2009), while there is less information regarding the current status of experiential education in Canada and the UK.

Summary

Although various problems have been identified and challenges encountered, the need to include experiential or work based learning in pharmacy education has not been questioned. The concerns raised tend to focus on practical logistics of placing pharmacy students at appropriate practice sites, with well-trained preceptors, and the need to ensure that the work-

based placement delivers a positive learning experience which is well integrated with the pharmacy curricula's academic content.

2.6.3.2 Can we predict academic achievement in experiential learning programmes?

Attempts to correlate academic performance in the professional practice environment with pharmacy admission criteria have proven difficult (Kidd & Latif, 2003). Both the PCAT and CCTST scores were found to be predictors of success in practice-related courses and pharmacy practice experiences by Allen and Bond (2001). However, Kidd and Latif (2003) found that only CCTST scores correlated with advanced pharmacy practice GPA scores while PCAT was not a contributor to academic success in the experiential rotations completed in the fourth year of the PharmD programme.

Learning styles were not found to be a predictor of academic performance in experiential programmes (IPPEs and APPEs) when the PILS test instrument was administered to third and fourth year pharmacy students. Scores from subjective and objective evaluations were used for comparative purposes, and the majority of students (61%) identified Assimilator as their dominant learning style, with Converger as the second most common (29%) (Robles, Cox, & Seifert, 2012).

The Health Sciences Reasoning Test is a validated critical thinking skills test, with questions seated in a health science context. Test scores were found to have a weak or negligible correlation with academic performance in 29 courses through the PharmD curriculum, as well as academic performance in the experiential APPEs (Cox & McLaughlin, 2014).

While academic performance *per se* was not measured, Malaysian pharmacy students' self-reported perceptions of their preparedness to perform advanced clinical pharmacy skills

showed significant improvement in post-placement scores such as therapeutic, psychosocial and communication skills after nine weeks of clinical hospital-based placements (Hasan et al., 2013).

Sequential assignment of University of Oklahoma PharmD students to the same institution for both their IPPEs and APPEs was found to increase academic performance in an objectively administered examination (Dennis, Britton, Wheeler, & Carter, 2014). Advantages of the sequential design were seen to be the continuity which enabled students to become familiar with the environment and develop good preceptor-student relationships, with minimal orientation required on subsequent placements. Some limitations were identified which could have impacted on the results, which warrant further investigation. However, the impact of the placement duration on academic achievement has also been reported in medical students, where a longer placement significantly improved examination scores, as well as continuity of the attending physician for 4 weeks compared to 2 weeks (Griffith et al., 2009).

Thus in summary, although attempts have been made to identify predictors of academic performance in the clinical environment, the lack of positive results suggests more research is indicated.

2.7 SUMMARY OF CHAPTER TWO

This chapter has, therefore, reviewed the changes in the professional practice environment which triggered pharmacy curricular changes worldwide. The need for increased experiential learning in undergraduate pharmacy programmes has been described and the current developments in pharmacy education in developed and developing countries have been presented. In order to understand the context of the research, an overview of experiential learning theories was provided, before exploring research into a multitude of factors that have been investigated as possible predictors in academic achievement in pharmacy programmes.

Experiential learning in the clinical environment was then discussed, with a consideration of the underlying cognitive processes involved in the application of knowledge, clinical decision making, problem solving and critical thinking skills. Lastly, experiential learning from the perspectives of the student, pharmacy educator and preceptor were examined, and research was presented that has attempted to identify predictors of academic success in the clinical setting. Chapter Three will provide a detailed discussion of the research methodologies employed in the current research.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

Chapter Three will first present a discussion of the research paradigm and provide details of the research design. The various research methodologies utilised will then be discussed in detail, along with the ethical considerations relating to the research and data analysis techniques employed.

3.2 RESEARCH PARADIGM

3.2.1 The research paradigm in social sciences research

Thomas Kuhn (1970) is widely credited with popularising the concept of a paradigm in his monograph *The Structure of Scientific Revolutions*. He presented the term paradigm as a representation of a particular way of thinking that is commonly shared by a community of scientists, which is inclusive of the values, beliefs and methodologies shared by a discipline. Research paradigms are typically constructed from the underlying philosophical assumptions of the nature of reality (ontology), the ways of knowing (epistemology) and ethics and value systems (axiology), and often include methodological approaches (Chilisa & Kawulich, 2012). The theoretical framework has been referred to as the paradigm, in that it directs the way knowledge is studied and interpreted (Mackenzie & Knipe, 2006). Simply put, a paradigm can be considered as "a model or frame of reference through which to observe and understand" (Babbie, 2010, p. 33) or "a research culture" (Johnson & Onwuegbuzie, 2004). Morgan (2007) interpreted the term paradigm in terms of four concepts, namely a) paradigms as worldviews; b) paradigms as epistemological stances (he referred to the metaphysical paradigm, consisting of ontology, epistemology and methodology); c) paradigms as model examples of research; and d) paradigms as shared beliefs among a community of researchers. Many theoretical

paradigms have been presented for discussion and debate in the literature (Biesta, 2010; Mackenzie & Knipe, 2006; Morgan, 2007). For the purpose of this research, a research paradigm will be defined as the "cluster of beliefs and dictates, which, for scientists in a particular discipline, influences what should be studied, how research should be done, how results should be interpreted, and so on" (Bryman, 1988, p. 4). Historically, paradigms have been divided into two distinct, diametrically opposed viewpoints, namely positivist (using quantitative methodologies) and constructivist (using qualitative methodologies) (Johnson & Onwuegbuzie, 2004; Krauss, 2005).

Research, in the first half of the 21st century was largely quantitative, with its epistemological basis of positivism (Lund, 2012). Positivists believe that science is the only source of knowledge, as it measures independent facts about a single reality, is limited to what can be observed and measured (Chilisa & Kawulich, 2012), and the causes will probably determine the effects or outcomes (Creswell, 2003). By the end of the century, the philosophical basis of positivism was often substituted with post-positivism or critical realism (Lund, 2012). Quantitative methodologies emphasise objective measurement in data collection and analysis, where the object of the research is independent of the researcher and is viewed as a single concrete reality. These methodologies are characterised by hypothesis testing, measurement, causality, generalisation and replication and an objective approach to scientific inquiry (Johnson & Onwuegbuzie, 2004; Krauss, 2005; Lund, 2012; Morgan, 2007). Quantitative data are gathered through randomised controlled trials, surveys, tests and measurements in experiments. Typically deductive reasoning is employed, as the goal of the research is to test or verify a theory or hypothesis (Creswell, 2009).

Qualitative research is based on various forms of the constructivist (or interpretivist) paradigm which is rooted in the philosophies of phenomenology (human consciousness and self-awareness) and hermeneutics (interpretation) (Chilisa & Kawulich, 2012). Qualitative researchers are deeply opposed to the positivist's approach to research with its objective inquiry and generalisations that are time and context free (Johnson & Onwuegbuzie, 2004; Lund, 2012). The constructivist approach to research emphasises the social issues from the viewpoint of the subject, with a need to understand the human experience, believing that reality is socially constructed (Creswell, 2003), and therefore the way to understand a phenomenon is to view it in its context (Chilisa & Kawulich, 2012). Knowledge is derived from the meanings attached to the phenomena under study and researchers usually interact with the subject of the study in order to collect data (Creswell, 2009). Qualitative data is typically gathered through focus groups, interviews or observations. An approach using inductive reasoning may be included (Creswell, 2009) as constructivists do not start with a theory but rather generate theory and the hypothesis throughout the research process (Lund, 2012). Research findings tend to be context and time-dependent (Krauss, 2005; Mackenzie & Knipe, 2006). Morgan (2007) described qualitative research as emphasising an inductive-subjective-contextual approach.

Traditionally, quantitative and qualitative research methodologies with their respective research paradigms were applied independently of each other. The on-going, often contentious debate about the advantages and disadvantages of the two paradigms has been characterised by a general viewpoint that supports a complete incompatibility of these paradigms when constructing knowledge. In fact, Howe's incompatibility thesis (1988) argued that qualitative and quantitative paradigms and methodologies existed in direct opposition and as such, could not be used in combination (Lund, 2012). Johnson and Onwuegbuzie (2004) pointed out that a closer look at the two paradigms actually revealed

that commonalities did exist, and that researchers should rather ask which approach would be more useful and how the approaches could be combined, postulating that a pragmatic approach be considered.

3.2.2 Pragmatism and the rise of mixed methods research

Pragmatism is most often linked to John Dewey's transactional theory of knowing, as it supports a view that knowledge is about relationships between actions and consequences, so knowledge acquisition must involve action (Biesta, 2010). Pragmatism as a research paradigm focuses on the research problem and then uses relevant methodological approaches to understand the problem (Creswell, 2003). In short, a pragmatic approach to research supports a "needs-based or contingency approach to research method and concept selection" (Johnson & Onwuegbuzie, 2004, p. 17). Thus pragmatism embraces the use of multiple methodologies, different worldviews and underlying assumptions, and then encourages the use of diverse approaches when collecting and analysing data. Pragmatism is now generally accepted by many researchers as the philosophical basis for mixed methods research (Biesta, 2010; Creswell, 2009; Johnson & Onwuegbuzie, 2004; Morgan, 2007).

Mixed methods research was established in the late 1980's and, by 2000, was formally recognised as a research paradigm (Guest, 2012; Lund, 2012). Johnson and Onwuegbuzie (2004) proposed the acceptance of mixed methods research as a third research paradigm, arguing that the goal of mixed methods research is to utilise the strengths of both quantitative and qualitative research methodologies, and at the same time, to limit the weaknesses encountered with a single methodological approach. This stance is now widely accepted by many social science researchers. Mixed methods research was broadly defined by Tashakkori and Creswell (2007, p. 4) in the editorial of the first edition

of *The Journal of Mixed Methods Research* as "research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry".

Thus the current research is framed in a pragmatic paradigm, using a mixed methods approach, with the following justifications:-

a) Mixed methods research has been demonstrated to show superior capabilities when answering complex research questions, compared to a single qualitative or quantitative approach (Caruth, 2013; Lund, 2012). In an educational intervention study, such as the current study with its quasi-experimental design, the quantitative data can be used to measure causal effects, while the qualitative data collected from focus groups can explain how these effects were generated.
b) The combination of different perspectives gained from using qualitative and quantitative approaches can provide a more complete picture of the topic under investigation (Lund, 2012), namely in this research, the ELP. The qualitative data on the lived experiences and attitudes of the participants in this study added a deeper meaning and richness to the quantitative data collected, in order to understand the "why".
c) The convergence of results arising from two different methodologies strengthens the validity of the research findings and conclusions though the process of triangulation (Bronstein & Kovacs, 2013; Creswell, 2009), while the presence of divergent results should lead to further research, theory development and hypothesis testing (Morgan, 2007).
d) Mixed methods research has been used as a methodological approach for intervention based research designs (Florczak, 2014; Maudsley, 2011)

3.3 RESEARCH DESIGN

The focus of the current research was the question, "What would be the effect of an intervention aimed at supporting undergraduate pharmacy students during clinical placements, on academic achievement in, and student attitudes towards, experiential learning programmes?" The need for multiple methodologies is evident from the research question, as not only measurements of academic achievement will be required (quantitative data), but in addition, qualitative data is indicated in order to provide rich descriptive details of the pharmacy students' attitudes towards and experiences of the ELP.

The researcher, therefore, utilised a mixed methods approach in the form of a quasi-experimental research design, which was intervention-based, with pre- and post-testing of the comparator (control) and experimental groups. Cause-and-effect relationships are typically determined using experimental research designs which require random assignment of participants to control and experimental groups (Mertler, 2012). The randomisation process ensures that, prior to the treatment / intervention, both groups of participants are, on average, equal in all measured and unmeasured variables. However, randomised experiments are not always possible to implement for ethical, legal or practical reasons and, tend to be relatively rare in education research, particularly when assessing the impact of educational interventions (Steiner, Wroblewski, & Cook, 2009). When randomisation is not a viable option, a quasi-experimental research design is employed, which incorporates all the characteristics of experimental research, *except* random assignment of participants (Mertler, 2012). A non-randomised research design can however be strengthened by using a pre-test, post-test, non-equivalent control group design, in which the participants are selected by a third party or administrator into the treatment arm, and both the control and experimental groups undergo pre-testing to establish equivalency, prior to the introduction of the experimental treatment (Mertler,

2012; Steiner et al., 2009). Thus, due to the potentially beneficial nature of the educational intervention in the current research, random assignment of participants to comparator and experimental groups was not deemed to be ethically feasible, and a quasi-experimental design was adopted. Selection into the experimental or treatment group was determined by the year of first registration for the module Pharmacology4, so the researcher determined that a 2014 registration would be the control group and a 2015 registration would be the experimental group.

The research took place over two consecutive academic years (2014 and 2015), with two different groups of final year BPharm students, registered for the Pharmacology4 module for the first time. The comparator group in Phase One (2014) participated in the ELP which was conducted as usual. In Phase Two (2015), the experimental group participated in the ELP, during which the intervention, in the form of supplementary academic support, was implemented. Figure 3.1 provides an overview of the design, showing the mixed methods approach of data collection within the different phases, as well as the development and implementation of the intervention during the 2015 ELP, and the timing of qualitative and quantitative data collection periods.

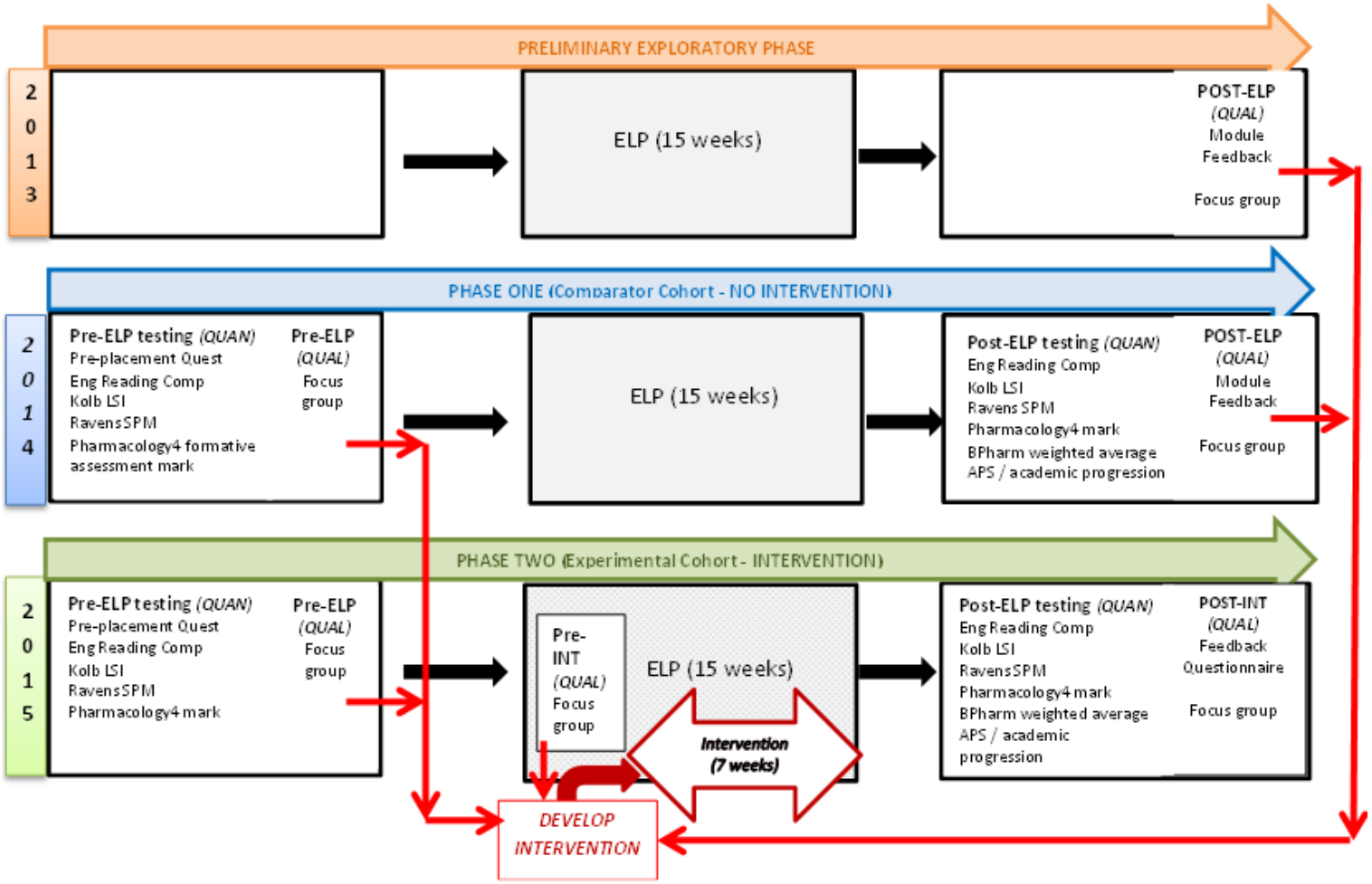


Figure 3.1

The study design, showing the three phases of the research, the timing of data collection and the development and implementation of the intervention. Qualitative data collected during the preliminary phase, Phase One (pre- and post-ELP) and Phase Two (pre-ELP and pre-INT) was used in an iterative process to design the intervention (INT)

The typology of the mixed methods approach will be discussed further in Section 3.4 in this chapter. Data was collected during the exploratory Preliminary Phase in 2013 and during Phase One and Phase Two of the study (Figure 3.1). Qualitative data was collected during the Preliminary Phase in 2013 (post-ELP), during the pre-ELP and the post-ELP periods in 2014 and 2015 and before and after implementation of the intervention in 2015. The qualitative data was used to: a) explore students' experiences of the ELP in order to describe student attitudes towards and expectations of the clinical placements (i.e. research objective 8) and; b) to develop and evaluate an intervention aimed at providing academic support in the ELP (i.e. research objective 9). Quantitative data was gathered pre- and post- ELP during Phase One (2014) from the comparator cohort and during Phase Two (2015) from the experimental cohort, and was collected in order to obtain objective measurements of student achievement in order to meet research objectives 1, 2, 3, 4, 5, 6, 7 and 9 (Chapter One, Section 1.3).

3.4 MIXED METHODS RESEARCH TYPOLOGY

Much has been written on typologies which describe and classify mixed methods research design (Bronstein & Kovacs, 2013; Guest, 2012; Leech & Onwuegbuzie, 2009; Lund, 2012; Tashakkori & Teddlie, 2010). A three dimensional framework for mixed methods research designs was described by Leech and Onwuegbuzie (2009) and Creswell (2009), which highlighted the need to identify: a) extent of mixing (partially or fully mixed); b) timing (concurrent or sequential) and c) weighting (equal or dominant status of quantitative versus qualitative) (Figure 3.2). With reference to the mixed methods research designs (Figure 3.2), the current research utilised a **concurrent** approach in that qualitative and quantitative data were collected at the same time during the same phases and the dominant status was **quantitative,** with **partial mixing** of the data at the data analysis stage.

		CONCURRENT	SEQUENTIAL
PARADIGM EMPHASIS	**EQUAL STATUS**	QUAL + QUAN	QUAL → QUAN QUAN → QUAL
	DOMINANT STATUS	QUAL + quan QUAN + qual	QUAL → quan qual → QUAN QUAN → qual quan → QUAL

QUAN = quantitative; QUAL = qualitative; + = a concurrent relationship; → = a sequential relationship: Capital letters denote priority or high weighting; Lower case letters denote a lower weighting.

Figure 3.2
Typology of mixed methods research designs (adapted from Leech and Onwuegbuzie's mixed method design matrix (2009)

Creswell (2015) describes an advanced mixed methods research design, which incorporates an intervention. In this design, the aim is to investigate a problem by conducting an experiment whereby one group acts as a control, and the second group participates in the intervention. The advanced mixed methods design was therefore employed in the current research, where the problem was the difficulties experienced by pharmacy students in application of knowledge in the clinical setting. The quasi-experimental, intervention-based, mixed methods design incorporated quantitative data as a measure of the outcomes (academic achievement in the ELP), while qualitative data provided supplementary information that led to the design of the intervention and described the participants' experiences of and attitudes towards the ELP. Pre- and post-intervention testing provided quantitative data which was therefore further enhanced by qualitative data obtained concurrently within the pre- and post-test experimental model (Creswell, 2015). The data were mixed or triangulated at the data analysis stage, when the quantitative data were compared to the qualitative data for interpretation and discussion of the findings (Creswell, 2009).

3.5 STUDY SITE AND SAMPLE

The research site was the NMMU in the Eastern Cape province of South Africa. The study population consisted of students registered for the BPharm degree at NMMU. The study sample consisted of final year undergraduate BPharm students registered (for the first time) for the 40 credit, exit-level module Pharmacology: Applied Therapeutics (Pharmacology4). Students re-registering for Pharmacology4 were excluded from the study.

Non-probability, convenience sampling was utilised during quantitative data collection as the participating students were accessible and available and willing to participate in the research (Wagner et al., 2012). Students who did not wish to be involved in the research project were not excluded from involvement in the academic activities. However, no data was collected from the non-participating students.

Non-probability, purposive sampling was employed during the qualitative data collection. All participating students registered for Pharmacology4 were emailed an invitation to attend a focus group session on the ELP. This sampling method resulted in a small subset of the cohort accepting the invitation and participating in the discussions.

3.6 ETHICAL CONSIDERATIONS

Ethical approval was granted by the NMMU Research Ethics Committee in October 2013 (NMMU ethics clearance reference number: H13-HEA-PHA-008**,** Appendix A). The final year pharmacy students provided written informed consent that they were: willing to participate in the research; would allow the researcher to access their student records and; understood that their participation was voluntary and that they could withdraw at any stage. The aim and objectives of the research were made known verbally

and in writing to all participants (Appendix B). Confidentiality of the participants was ensured by using a unique study number for each participant, so that no respondent identifiers could be linked to the published or disseminated data. When completing the questionnaires and tests, the NMMU student number was used, but no name. An independent research assistant (not involved with the Department of Pharmacy) captured the NMMU student numbers into a Microsoft Excel spreadsheet and then assigned a unique study number for each participant. The researcher only worked with the unique study numbers, without the link to the NMMU student number. The research was conducted according to the guidelines outlined in the Belmont Report on Ethical Principles and Guidelines for the Protection of Human Subjects in Research (1979) as well as the Singapore Statement on Research Integrity (Kleinert, 2010).

3.7 PROCESS OF DATA COLLECTION

Data were initially collected during the exploratory Preliminary Phase in 2013 post-ELP, and then during the pre-ELP and post-ELP periods in Phase One (2014) and Phase Two (2015), from the comparator and experimental cohorts respectively (Figure 3.1). In addition, data were collected prior to and on completion of the intervention from the experimental cohort (Phase Two, 2015). Table 3.1 provides an overview of the data collection, showing the type of data collected during the different phases of the research, and the timing of the data collection in relation to the ELP. This section will present the various data collection processes employed. The reliability and validity of the methodologies utilised will be discussed in section 3.10. The quantitative data collection process will be discussed first, followed by the qualitative data collection.

Table 3.1
Overview of the three phases of the research, showing the nature of the quantitative and qualitative data collected during each phase, in relation to the ELP.

Pre-ELP	**ELP**	**Post-ELP**
PRELIMINARY PHASE (2013)		
		QUALITATIVE DATA Pharmacology4 Module Feedback questionnaire (Post ELP) Focus group (Post ELP)
PHASE ONE (2014) - NO INTERVENTION (*comparator cohort*)		
QUANTITATIVE DATA Pre-ELP questionnaire English reading comprehension Raven's SPM Kolb LSI Pharmacology4 formative assessment		*QUANTITATIVE DATA* English reading comprehension Raven's SPM Kolb LSI Pharmacology4 summative assessment
QUALITATIVE DATA Focus group (pre-ELP)		*QUALITATIVE DATA* Pharmacology4 Module Feedback Questionnaire (Post ELP) Focus group (post ELP)
		ADDITIONAL DATA APS and academic progression rate BPharm weighted average per year Pharmacology2 and Pharmacology3 summative written assessment marks
PHASE TWO (2015) - INTERVENTION *(experimental cohort)*		
QUANTITATIVE DATA Pre-ELP questionnaire English reading comprehension Raven's SPM Kolb LSI Pharmacology4 formative assessment		*QUANTITATIVE DATA* English reading comprehension Raven's SPM Kolb LSI Pharmacology4 summative assessment
QUALITATIVE DATA Focus group (pre-ELP)	*QUALITATIVE DATA* Focus group (Pre-intervention)	*QUALITATIVE DATA* Post-Intervention Feedback questionnaire Focus group (Post- Intervention)
		ADDITIONAL DATA APS and academic progression rate BPharm weighted average per year Pharmacology2 and Pharmacology3 summative written assessment marks

3.7.1 QUANTITATIVE DATA

Quantitative data were collected from the comparator and experimental cohorts before and after the ELP, during Phase One and Phase Two (Table 3.1). Data collected

from the comparator group served as baseline data as this cohort participated in the ELP but were not exposed to the intervention. The experimental cohort participated in the intervention which was implemented during the ELP in Phase Two, in the form of supplementary academic support sessions.

The following instruments were used during quantitative data collection (Table 3.1) and will therefore be discussed in this section: Pre-ELP questionnaire; English Reading Comprehension test; Raven's Standard Progressive Matrices; Kolb's Learning Style Inventory; Pharmacology2 and Pharmacology3 summative assessment mark, as a measure of academic achievement in Pharmacology; Pharmacology4 open book case study based assessment marks, as a measure of academic achievement in the ELP; weighted average of BPharm module marks per academic year as a measure of academic achievement in BPharm; the Admission Points Score (APS) as a measure of academic achievement at the end of secondary level of education (i.e. pre-university prior to entering the BPharm programme); the rate of academic progression through the BPharm; and the retrospective review of Pharmacology summative assessment papers in BPharm2 and BPharm3.

3.7.1.1. Pre-ELP Questionnaire

A researcher-designed, purpose-specific questionnaire was developed and administered to all participants in Phase One (comparator cohort) and Phase Two (experimental cohort), before commencement of the ELP (Table 3.1). The aim of the questionnaire was to collect demographic information pertaining to the study sample, and date pertaining to: home language and language of education; and the extent and nature of pharmacy work-based experience prior to commencement of the ELP (Appendix D).

Closed questions were utilised and the questionnaire was group-administered under test conditions in April 2014 and 2015 to the study population, before the ELP commenced.

3.7.1.2 English Reading Comprehension Test

The English Reading Comprehension test was developed and used by NMMU for prospective student assessment prior to enrolment in university programmes and evaluates reading skills and sentence meaning. The test was developed and validated at NMMU (Foxcroft et al., 2002). The reason for using the test in the context of this research was to establish the level of English reading comprehension ability of the final year BPharm students. Problem solving and clinical decision making in the ELP requires an understanding of the underlying medical conditions, as well as the pharmaco-therapeutic management of the condition, and, therefore, requires extensive consultation of the current medical literature by the students. Written permission to use the test for research purposes was obtained from the NMMU Centre for Access Assessment and Research (Appendix E).

The English Reading Comprehension test was administered to all participating students before commencement of the ELP, in Phase One (comparator group) and Phase Two (experimental group). On completion of the ELP, in October (after a six month period), the test was re-administered (Table 3.1). Pre- and post-ELP scores were then compared within each cohort and between the cohorts.

The computer-based test was administered under test conditions. The participants completed the test at their own pace, as no time limit was imposed. The test was composed of a series of paragraphs of increasing complexity. A set of questions in multiple choice format followed each paragraph and participants had to select the most appropriate answer, before moving on to read the next section. An overall numerical score out of 100 was

assigned for the test and the level of English Reading comprehension was then determined and categorised (Table 3.2). Reading comprehension ability was categorised as: *proficient* (test score between 86 and 100); *functional* (between 66 and 85); *expanding* (between 43 and 65) and; *developing* (between zero and 42).

Table 3.2
Categorisation and Interpretation of the English Reading Comprehension test score (Source: Centre for Access, Assessment and Research, NMMU)

Classification according to test scores	**Test Score**	**Interpretation**
Proficient	86 to 100	Able to comprehend passages that, although short, are somewhat complex in terms of the ideas conveyed, and that deal with academic subject matter, often in a theoretical framework. Able to: Extract points that are merely implied; Follow moderately complex arguments or speculations; Recognise tone; Analyse the logic implied by the author in making an argument.
Functional	66 to 85	Able to comprehend short passages that are characterised by moderately uncomplicated ideas and organisation. Able to: Answer questions that require them to synthesise information, including gauging point of view and intended audience; Recognise organising principles in a paragraph or passage; Identify contradictory or contrasting statements.
Expanding	43 to 65	Able to comprehend short passages that are characterised by uncomplicated ideas, straightforward presentation, and for the most part, subject matter that reflects everyday experience. Able to:- Recognise the main idea and less central ideas; Recognise the tone of the passage when questions do not require fine distinctions; Recognise relationships between sentences, such as the use of one sentence to illustrate another.
Developing	0 to 42	Able to demonstrate the following skills:-Locate information in short, simple passages by answering literal comprehension questions; Answer simple questions where the wording in the answer is the same as that of the passage.

3.7.1.3 Raven's Standard Progressive Matrices (SPM)

As mentioned in Chapter Two, pharmacy graduates are expected to possess critical thinking skills and good problem solving ability in order to apply pharmaceutical knowledge to the problems encountered in practice or the clinical setting (Wiedenmayer et al., 2006). Problem solving is considered to be a high-order thinking skill, closely linked to critical thinking (Oderda et al., 2010), and the process of problem solving in the clinical environment depends on the application of knowledge. Thus Raven's Standard

Progressive Matrices (SPM) was selected as an indicator of problem solving ability for the context of this research. Raven's SPM test was originally developed to measure the eductive ability of ***g*** (general intelligence factor) as defined in Spearman's theory of cognitive ability (Chapter Two, Section 2.5.2)**,** namely the ability to make sense and meaning out of complex or confusing data; the ability to perceive new patterns and relationships, and to forge (largely non-verbal) constructs which make it easy to handle complexity (Raven et al., 2000). While Raven et al. (1998) specifically mention that eductive ability is not merely problem solving ability, their Progressive Matrices have been used as a simple test of problem solving by both researchers and in daily practice by prospective employers (Hamel & Schmittmann, 2006; Rushton & Skuy, 2001). Raven's SPM is widely recognised as a nonverbal assessment tool as it minimises the impact of language skills on performance. This is advantageous when applied to the multi-cultural and multi-linguistic setting of higher education in South Africa.

Raven's SPM was administered before commencement of the ELP (in April) during Phase One (2014) to the comparator cohort and during Phase Two (2015) to the experimental cohort (Table 3.1). On completion of the ELP (in October), the test was re-administered to both cohorts (2014 and 2015) under test conditions, following the same procedure outline above. The pre- and post ELP test scores were then subsequently compared within each cohort and between the comparator and experimental cohorts.

The format of Raven's SPM is based on diagrammatic puzzles, and each puzzle or problem has a piece missing which the participant must select from several options. Raven's SPM consists of five sets of 12 problems, each of which begins with simple problems and progresses with increasing level of difficulty (Raven et al., 2000). The paper based test was group-administered under test conditions. Each student completed an

individual answer sheet by marking their answer with an "x", after studying the problem and possible solutions. Verbal instructions were provided before the start of the test and the first problem was projected onto a screen as an illustration of how to solve the problem and complete the answer sheet. On completion of the five sets (60 problems in total), the students submitted their completed answer sheets, so that the scores could be calculated and recorded by the researcher. Participating students were able to work at their own pace, and no time limit was imposed.

Approval to use the test for research purposes was obtained on purchase of the standardised tool from the authorised supplier in South Africa.

3.7.1.4 Kolb's Learning Style Inventory (LSI)

Experiential learning demands a different approach to learning, as the learner moves from a very controlled and familiar classroom setting, to a real-world, unfamiliar practice environment (Stupans & Owen, 2009; Yardley et al., 2012). David Kolb (1984, p. 38) defined learning as "the process whereby knowledge is created through the transformation of experience". As described in Chapter Two (Section 2.5.2), Kolb's model of experiential learning proposed that learning occurs in a four stage cycle, beginning with a *concrete experience* (CE), followed by *reflective observation* (RO), which leads to *abstract* conceptualization (AC), which enables *active experimentation* (AE). Kolb's LSI assesses six variables: four primary scores based on the four learning orientations — Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE), and two combination scores that indicate an learner's preference for abstractness over concreteness (AC-CE) and action over reflection (AE-RO) (D. Kolb, 1984). Learners can then be described as divergers, convergers, assimilators or accommodators (Chapter 2, Figure 2.1).

Although not without its critics, Kolb's Learning Style Inventory (LSI) is one of thirteen learning style models recognised as major contributors to the field of experiential learning (Coffield et al., 2004), and is the most commonly used tool used in medical and pharmacy students, and professionals (Romanelli et al., 2009). For these reasons, it was selected for this research, as well as the fact that it has an experiential basis, which is well suited to the topic of this research, namely the experiential learning programme. Permission to use Kolb LSI version 3.1 for the purposes of this research was obtained in writing from the Hay Group (Appendix F).

In Phases One (2014) and Two (2015), Kolb LSI was group-administered before commencement of the ELP (in April) to both cohorts (comparator and experimental) (Table 3.1). The LSI was paper-based and each participant completed the 12-item validated question sheet as well as the profile graph sheet and scoring grid, under test conditions. Verbal and visual instructions on how to complete the LSI were provided prior to the commencement of the test and participants handed in the LSI on completion of the test. Participants were not restricted in terms of time, so the completion of the test was self-paced. At the end of October (i.e. six months later) and on completion of the ELP, Kolb's LSI was re-administered to the respective cohorts in Phase One (2014) and Phase Two (2015) under test conditions, following the same procedure as outlined above. The pre- and post ELP LSI scores were compared within each cohort and between the comparator and experimental cohorts.

3.7.1.5 Academic achievement in Pharmacology2 and Pharmacology3

The written Pharmacology examination was selected as a measure of academic achievement in Pharmacology prior to Pharmacology4, using the mark obtained for the

summative (November) assessment (100 mark, closed-book written examination). If students had repeated the module (Pharmacology2 or Pharmacology3) or qualified for a re-examination, the mark obtained on first attempt at the examination was used. Marks were presented as a percentage, and were obtained from the NMMU Business Information system.

3.7.1.6 Academic achievement in Pharmacology4

The method of assessment in Pharmacology4 differs from Pharmacology2 and Pharmacology3 in that an open-book, clinical case study format is utilised. Two formative assessments are written, with an optional third assessment paper, before the final summative written assessment in November on completion of the ELP and module.

For the purposes of this research, the assessment marks from the first formative assessment and the final summative assessment were obtained from both the comparator (Phase One, 2014) and experimental (Phase Two, 2015) cohorts (Table 3.1). The identical Pharmacology4 open-book case study-based assessment papers were administered to both comparator (2014) and experimental (2015) cohorts. The question papers were retrieved at the end of the assessment and were not released to students. This ensured that the Phase Two (2015) cohort had not been exposed to the assessment paper written by the Phase One (2014) cohort, and enabled a comparison of assessment marks between the two cohorts.

Pre- and post-ELP open book, clinical case study-based assessment marks were utilised. The first formative assessment was written after each student in the respective cohort had completed one clinical rotation, at the start of the ELP. The formative assessment provided a measure of academic achievement in the new format of assessment, namely the open book, clinical case study based papers, as the ELP commenced. Equivalency of academic achievement between the two cohorts could therefore be

determined at the start of the ELP. The post-ELP summative assessment was written by the both cohorts (2014 and 2015) during the final November examination period, at the end of the academic year. The mark for the written assessment was expressed as a percentage, and marks were obtained from the NMMU Business Information system. The summative Pharmacology4 assessment mark was used as an indicator of academic achievement in the ELP, and also as a measure of the impact of the intervention. Comparison of pre- and post-ELP assessment marks within each cohort provided an indication of the extent of development of clinical problem solving skills over the period of the ELP.

3.7.1.7 Retrospective review of Pharmacology assessments

Pharmacology2 and Pharmacology3 summative written assessment papers were reviewed and analysed, according to an approach based on Bloom's taxonomy which was reported by Kim et al. (2012), The intention of conducting the retrospective review was to identify the extent to which problem solving and application of pharmacological knowledge was assessed in summative written Pharmacology2 and Pharmacology3 assessments at NMMU, prior to the ELP in BPharm4. The four summative examination papers reviewed were the 2012 Pharmacology2 paper and the 2013 Pharmacology3 paper, as these November examination papers would have been written by the Phase One cohort of students. Similarly, the Phase Two cohort of students would have written the 2013 Pharmacology2 paper and the 2014 Pharmacology3 paper.

The questions in each assessment paper were classified into five categories based on the cognitive domains described in Bloom's taxonomy (1956) starting with the lower order thinking skills of knowledge and comprehension and moving into the higher order thinking skills of application, analysis, and synthesis and evaluation. The last two

categories of synthesis and evaluation were combined into one category for the purposes of this research, based on the fact that the order of these categories is often reversed. Bloom's original taxonomy (1956) describes synthesis, followed by evaluation, while the revision of Bloom's Taxonomy by L. Anderson and Krathwohl (2001) has the order reversed as "evaluate" and "create". It was also considered unlikely that these categories would be utilised in undergraduate Pharmacology2 and Pharmacology3 assessment papers.

Each question in the assessment paper was categorised according to the cognitive domain (Table 3.3), using specific keywords to guide the categorisation as shown in Figure 2.3 (L. Anderson & Krathwohl, 2001), as well as the suggested classification of pharmacotherapeutic-based questions reported by Kim et al. (2012). The total number of marks (/100) in the assessment paper assigned to each cognitive domain was then calculated and expressed as a percentage, in order to obtain an overview of the categories utilised in the assessment papers. The chronological progression of the development of application of knowledge was also noted by comparing the overall percentage of application in Pharmacology2 assessment papers to Pharmacology3 assessment papers.

Table 3.3

Retrospective review of Pharmacology assessment papers using scores assigned to the cognitive domains of Bloom's Taxonomy

Cognitive domains of Bloom's taxonomy	**Category of pharmacology question** (Kim et al, 2012)	**Examples of key words** in the questions that guided the categorisation of each question**	**Example from a Pharmacology assessment paper at NMMU**	**Category of Cognitive Domain**
Knowledge ('remember")	Factual recall	Define, List, Identify, Recognise, Recall, Name	List two examples of a beta$_1$-agonist	***1***
Comprehension ("understand")	Understand the meaning of single concept	Compare, Describe, Predict, Explain, Interpret, Classify, Clarify, Summarise	Briefly outline the mechanism by which mannitol exerts its effect in the management of acute glaucoma.	***2***
Application ("apply")	Use a concept in a patient case	Respond, Provide, Carry out, Use, comment on the appropriateness of the medication	Mirtazepine administered as an antidepressant to a patient that had suffered a stroke and is treated with warfarin as per INR for the stroke.	***3***
Analysis ("analyse")	Differentiate multiple factors in a patient case	Comment on the appropriateness of the medication (requires organisation and integration of information)	Mrs Betes (75yrs) was diagnosed with Diabetes Mellitus in 2003. She was initiated on therapy with metformin, and has had the dose increased to the highest tolerable dose of 500mg tds. As Mrs Betes' HbA1C has been elevated over the last few months, the doctor has now added glibenclamide 10 mg mané. Mrs Betes' GP phones the pharmacist to ask whether any additional medication is required for control of Mrs Betes' diabetes mellitus and associated complications.	***4***
Synthesis and Evaluation ("create" and "evaluate") (These categories were combined for the purposes of this research)	1. Apply multiple factors in a patient case 2. Assess given therapies based on multiple factors in a patient case 3. Formulate a plan of action	Comment on the appropriateness of the medications and make recommendations, with a plan of action (requires critiquing, monitoring, planning)	Refer to Appendix C for an example of an open book, clinical case study based assessment	***5***

*Note: Revised nomenclature shown in brackets as used by L. Anderson & Krathwohl, 2001; **Note: Keywords used by L. Anderson & Krathwohl, 2001 & Kim et al, 2012.

The retrospective review was first conducted by the researcher, and a second review was conducted by an independent reviewer who lectured pharmacology. The results of the review were then compared for validation purposes, and the average score obtained from the combined scores was calculated.

3.7.1.8. Admission Points Score (APS), Admission Route and Academic Progression

The APS was used as an indicator of academic ability prior to the first year of university and therefore provided a measure of academic achievement at the secondary level of education. The admission route into the BPharm programme was indicated by the BPharm registration code, while the rate of academic progression through the BPharm programme was calculated as an indicator of academic achievement.

Admission Points Score (APS)

The Admission Points Score (APS) is used by most universities in South Africa as an admission tool, although calculation of the score and the specific subjects included may differ from university to university. The National Senior Certificate (NSC) is the final exit qualification for the secondary level of education in South Africa, and is written at the end of Grade 12 (Department of Basic Education, 2016). The NSC is, therefore, the school leaving examination in South Africa and is also known as the matriculation (matric) certificate. A minimum of seven subjects must be passed, including two compulsory official South African languages (Department of Basic Education, 2016).

At NMMU, the APS is calculated from the examination marks obtained for seven NSC subjects (NMMU, 2016). An APS score is assigned by NMMU to each subject's percentage mark obtained in the NSC examinations and a total APS score determined (Table 3.4). Each qualification offered by NMMU has a minimum entry level APS, while some qualifications such as the BPharm degree require that specific additional criteria

must be met for compulsory NSC subjects. The APS for the BPharm degree is 38, with a NSC achievement rating of at least 5 (60 to 69%) for Mathematics and Physical Science, and as specified by NMMU for all degree programmes, English, Afrikaans or isiXhosa as home language or first additional language on at least a level 3 (40 to 49%) (NMMU, 2012).

Table 3.4
Calculation of the NMMU Admission Points Score (APS) from marks obtained in the National Senior Certificate (NSC) examination (Source: NMMU, 2016)

National Senior Certificate (NSC)	Mark obtained (%) per subject written for NSC	Admission Points Score (APS)	APS (%)
		8	90 - 100%
7	80 – 100 %	**7**	80 - 89%
6	70 – 79 %	**6**	70 - 79%
5	60 – 69 %	**5**	60 - 69%
4	50 – 59 %	**4**	50 - 59%
3	40 – 49 %	**3**	40 - 49%
2	30 – 39 %	**2**	30 - 39%
1	0 – 29 %	**0**	0 - 29%

In the current research project, the APS was used as an indicator of academic ability on entering university (Table 3.1) and thus, is similar to the pre-pharmacy GPA used in North America (Chapter Two, Section 2.5.1.2). The APS total score for each participant was obtained from the NMMU Business Information system.

BPharm registration code

The majority of BPharm students at NMMU are registered for the four year BPharm degree under the registration code 20300, which means all admission requirements were met in terms of the APS (minimum score of 38) and specific subject

criteria. Borderline applicants with an APS between 35 and 37 are referred to write a set of pre-admission screening tests, the NMMU Access Assessment Tests (developed and administered by NMMU's Centre for Access, Assessment and Research), and depending on the outcome, will be admitted to the four or five year BPharm programme (NMMU, 2012). Applicants who do not meet the admission requirements but have an APS between 30 and 34, are required to write the Access Assessment Tests, and if they perform well, are admitted into the five year Extended BPharm programme, under the registration code 67300 (NMMU, 2012). The BPharm registration code for each participant in the comparator (Phase One, 2014) and experimental (Phase Two, 2015) cohorts was obtained from the NMMU Business Information system, in order to calculate the rate of academic progression.

Academic progression through the BPharm programme

The rate of academic progression through the BPharm programme at NMMU was calculated by subtracting the year of first registration in Pharmacology4, from the year of first registration in BPharm1, in order to determine the number of years of registration in the BPharm programme. The registration code was used to identify the Extended BPharm students who were registered for the five year, rather than the four year BPharm programme. The data obtained were used to establish if there was a relationship between the APS, BPharm registration code and academic progression in the BPharm degree and academic achievement in the ELP (Table 1.3, research objective 2).

3.7.1.9 Academic achievement in the BPharm programme

The weighted average of the BPharm module marks, for each academic year, was used as a measure of academic achievement in the BPharm programme (Table 3.1). Final module marks were downloaded from NMMU's Business Information System. The

weighted average mark for the academic year was calculated using the student's final module mark, and the weighting was calculated according to the number of credits of the specific module and the total number of credits for the academic year (Table 3.5).

As previously described, first year students enrolling in the BPharm programme at NMMU may register for the four year BPharm programme (registration code 20300) or the five year, Extended BPharm programme (registration code 67300), in which the first year modules are completed over a two year period in order to include additional academic support modules (Table 3.6). On completion of BPharm1, the Extended BPharm students then continue with the four year BPharm programme in order to complete the BPharm2, BPharm3 and BPharm4 modules.

For the current study, calculation of the BPharm1 weighted average for students enrolled in the Extended BPharm programme, year 1 and year 2 of the Extended BPharm programme were combined into one year (using the total of 120 credits). Written informed consent was obtained by the researcher, from each participant, to access their student record and module marks, prior to commencement of the data collection process.

Table 3.5

Modules presented in the four year BPharm programme, showing the module code, number of credits and weighting used to calculate the weighted average

(Sourced from NMMU Prospectus: Health Science. 2012)

BPharm Registration Code 20300 (4 year programme)

Module Names	Module Code	Credits	Weighting
BPharm1 Modules			
Physiology and related pathophysiology of human cellular, muscular and endocrine systems	ZSP101	10	0.08
Physiology and related pathophysiology of human nervous system and the senses	ZSP102	10	0.08
Physiology and related pathophysiology of the human circulatory, respiratory and immune systems	ZSP103	10	0.08
Physiology and related pathophysiology of human digestion, reproduction, and fluid balance	ZSP104	10	0.08
Anatomy for Pharmacy 101	ZAN101	9	0.07
Anatomy for Pharmacists 102	ZAN102	7	0.06
Mechanics and Thermodynamics	FBB101	7	0.06
Electricity, Optics and Atomics	FBB102	7	0.06
Chemistry, General	CHG101	15	0.12
Chemistry Inorganic	CHI101	6	0.05
Chemistry Organic	CHO101	6	0.05
Computing Fundamentals	WRFC101	8	0.07
Professional Practice	ZP103	13	0.11
Total credit value for BPharm1 = 121			
BPharm2 Modules			
Pharmacology	ZCL203	30	0.24
Biomolecules in Pharmacy	ZBC201	7	0.06
Metabolism for Pharmacists	ZBC202	11	0.09
Pharmaceutics	ZCT210	28	0.23
Pharmaceutical Chemistry - Analytical	ZCH201	7	0.06
Pharmaceutical Chemistry - Inorganic	ZCH202	5	0.04
Pharmaceutical Chemistry - Organic	ZCH203	11	0.09
Pharmaceutical Chemistry - Physical	ZCH204	7	0.06
Pharmaceutical Care	ZP203	18	0.15
Total credit value for BPharm2 = 124			
BPharm3 Modules			
Pharmacology	ZCL303	30	0.25
Pharmaceutics	ZCT312	18	0.15
Pharmaceutical Health Care	ZP301	24	0.20
Business Practice	ZP302	12	0.10
Molecular structure and application	ZCH301	12	0.10
Molecule structure and drug action	ZCH302	12	0.10
Microbiology for Pharmacy	ZMB310	13	0.11
Total credit value for BPharm3 = 121			
BPharm4 Modules			
Pharmacology - Applied Therapeutics	ZCL401	40	0.32
Pharmaceutical Manufacturing Practice	ZCT412	24	0.19
Pharmacy Financial Practice	ZP411	9	0.07
Professional Practice	ZP402	9	0.07
Practical Professional Practice	ZP403	6	0.05
Molecular structure and drug action	ZCH401	12	0.10
Xhosa for Pharmacists	LXH401	4	0.03
Pharmacy Research	ZPE411	20	0.16
Total credit value for BPharm4 = 124			

Table 3.6
Modules presented in the five year Extended BPharm programme, showing the module code, number of credits and weighting used to calculate the weighted average
(Sourced from NMMU Prospectus: Health Sciences.2012)

BPharm Registration Code 67300 (5 year programme)

Module Names	Module Code	Credits	Weighting
Extended BPharm1 Modules - Year 1			
English for Science	LEA1X1	4	0.07
Academic and Life Skills development	ALM111	4	0.07
Pre-calculus	MATF1X1	4	0.07
Pre-calculus	MATF1X2	4	0.07
Computing Fundamentals	WRFC141	6	0.11
Extended General Chemistry	CHG1X1	5	0.09
Extended General Chemistry	CHG1X2	5	0.09
Concepts of Physics	FF101	4	0.07
Mechanics	FBB111	4	0.07
Anatomy and Physiology and related Pathophysiology of human cellular, skeletal, muscular and endocrine systems	ZAP111	11	0.20
Professional Practice	ZP113	5	0.09
Total credit value for Extended BPharm1- Year 1= 56			
Extended BPharm1 Modules - Year 2			
English for Pharmacy	LEA131	2	0.03
Academic and Life Skills Development	ALM112	2	0.03
Extended Inorganic Chemistry	CHIX1	7	0.11
Extended Organic Chemistry	CHO1X1	5	0.08
Electricity and Magnetism	FBB121	4	0.06
Properties of Matter	FBB112	4	0.06
Anatomy and Physiology and related Pathophysiology of human nervous system and the senses	ZAP112	11	0.17
Anatomy and Physiology and related Pathophysiology of human circulatory, respiratory & immune system 1	ZAP113	11	0.17
Anatomy and Physiology and related Pathophysiology of human circulatory, respiratory & immune system 2	ZAP114	11	0.17
Calculations for Pharmaceutics	MATP1X2	2	0.03
Professional Practice	ZP123	5	0.08
Total credit value for Extended BPharm1-Year 2 = 64			

3.7.2 Qualitative data

As illustrated in Figure 3.1 qualitative data were collected during the three phases over the research from the following sources: open ended questions in the Pharmacology4 Module Feedback questionnaire, completed post-ELP; focus group sessions held pre- and post- ELP; a Post-Intervention Feedback questionnaire and pre- and post-Intervention focus group sessions (Table 3.1).

3.7.2.1 Pharmacology4 Module Feedback questionnaire

In the Preliminary Phase (2013) and Phase One (2014), the Pharmacology4 Module Feedback questionnaire was group-administered to all participating students on

completion of the ELP. The Pharmacology4 Module Feedback questionnaire included open ended questions which were qualitative in nature (Appendix G). The written data obtained was transcribed verbatim and the accuracy of the transcriptions verified by an independent research assistant. The transcripts were then analysed in order to identify dominant themes, using Atlas.ti® software. The themes were subsequently used to develop the discussion topics for the focus groups held with subsets of the 2013, 2014 and 2015 cohorts of students and also contributed to the development of the intervention in 2015.

3.7.2.2 Post-Intervention Feedback questionnaire

In Phase Two (2015), the experimental cohort completed a purpose-designed Post-Intervention Feedback questionnaire which utilised three open ended questions in order to explore the students' experience of the intervention (Appendix H). The questionnaire was group-administered post-ELP to the experimental cohort, under test conditions. The written data obtained was transcribed verbatim, and the accuracy of the transcriptions verified by an independent research assistant. Dominant themes were identified which were used to guide the discussion topics for the post-intervention focus group held with a subset of the 2015 cohort.

3.7.2.3 Focus groups

In the context of this research, Stewart and Shamdasani's definition of a focus group was deemed to be the most relevant and appropriate.

> The contemporary focus group interview generally involves 8 to 12 individuals who discuss a particular topic under the direction of a moderator who promotes interaction and ensures the discussion remains on the topic.
>
> (Stewart & Shamdasani, 2015, p. 40)

This methodology was selected as focus groups are widely accepted as an appropriate technique of data collection for the study of attitudes and experiences (Kitzinger, 1995; Krueger & Casey, 2000), as well as providing a method for evaluating how well a programme is working and how it could be improved (A. Williams & Katz, 2001). A key aspect of the focus group is the group dynamics, as the social interaction between participants is known to result in data which is both deeper and richer than one-on-one interviews (Kitzinger, 1995; Rabiee, 2004). Although a questionnaire based survey in the form of the module feedback was administered to all participants in the current research study, the inclusion of focus groups allowed further exploration and in-depth discussions around key issues identified in the survey. Stewart and Shamdasani (2015) identified that the use of focus groups in health sciences research often involves groups of individuals who share a common identity and goals (i.e. final year BPharm students in the current research), as well as some common concrete or real-life situation (i.e. the hospital based experiential learning programme). In the context of the current research, the focus groups were used to connect the researcher with the students in an informal, relaxed setting and to bring the student voice into the design of the intervention, adding both richness and depth to the quantitative data concurrently obtained (Gill, Stewart, Treasure, & Chadwick, 2008). The focus groups also facilitated the gathering of baseline data which informed the development of the intervention.

Participants were recruited via a general email which was distributed electronically to all students registered for the Pharmacology4 module. The email invited students to voluntarily participate in a focus group on a specific topic (the ELP), and provided the time, date and venue. This encouraged self-sampling by the student population and ensured that participation was voluntary. As suggested by Fern (2001), this method also allowed participants to be recruited independently of each other, contributing to heterogeneity

within each focus group. A rich diversity of participants from different cultural and socioeconomic backgrounds, academic ability and gender was produced which added a richer perspective and meaning to the data obtained as their background, opinions and beliefs differed (Stewart & Shamdasani, 2015) .

The method of conducting the focus groups followed the same approach each time, using recommendations made by several researchers (Beyea & Nicoll, 2000; Kitzinger, 1995; Krueger & Casey, 2002; Stewart & Shamdasani, 2015). The focus groups ranged in size from six to 14 participants. While it is generally accepted that the size of focus groups should be limited to six to eight participants, Stewart and Shamdasani (2015) pointed out that a slightly larger group was preferable to under-recruitment and unsatisfactory data arising from incomplete or limited discussions. They found that focus groups could work well with as few as three and as many as 14 participants. The venue was on campus, in a room with which participants were familiar. Refreshments were available on arrival at the venue, which put the participants at ease and created a relaxed environment (Beyea & Nicoll, 2000). The group was seated around an oval table, ensuring good eye contact with each other and the facilitator.

The researcher took the role of the facilitator or discussion leader, in order to keep the discussion focused on the specific topic and facilitate free talk. Krueger (1988) recommended that for experiential discussions, the facilitator should be someone who can relate to the students, with insight into the experiences under discussion. Three or four pre-defined questions were used to direct the discussions, although additional questions that arose during the sessions were used in order to clarify or explore an issue further. Each session started with an introduction by the facilitator, explaining the reason for the discussion and the need for everyone's opinions to be heard and respected. Every session

was audio-recorded for transcription purposes. Anonymity was ensured by the use of a numbering system, so in the transcribed notes of the audio recording, each participant was identified numerically as participant 1, participant 2, etc. A research assistant acted as the note-taker, ensuring the order of the discussion was noted, as well as the key points. The duration of the focus group discussions varied from 1 hour 24 minutes to 2 hours 19 minutes. This is in line with recommendations of 1 to 2 hours (Rabiee, 2004).

The audio recordings were transcribed, and subsequently verified by a second independent research assistant, by checking the transcripts against the audio recordings for consistency and accuracy, as a measure of reliability. The transcripts were finally verified by the researcher (Fern, 2001). Dominant themes were then identified by content analysis of the data, using Atlas.ti® software.

A total of six focus groups were conducted over the study period. The purpose and timing of the focus groups differed (Table 3.7) and will therefore be described in this section. During the exploratory, Preliminary Phase in 2013, a convenience sampling technique was used to invite the 2013 cohort of students registered for Pharmacology4 to complete the Pharmacology4 Module Feedback Questionnaire at the end of the academic year. A focus group was subsequently conducted with a sub-set of this cohort of students, using purposive sampling, in that all students registered for Pharmacology4 who had completed the ELP and had consented to participate in the research, were emailed an invitation to attend the focus group session in order to explore and discuss the students' experience of the ELP. Ten students accepted the invitation in 2013 (Table 3.7, focus group 1).

Table 3.7
Purpose and Timing of the Focus Groups

Focus Group	Phase	Timing	Number of Participants	Purpose of the Focus group	Research Objective
1	***Preliminary***	2013 (Post-ELP)	10	Explore attitudes towards and experiences of the ELP	8, 9
2	***Phase One***	2014 (Pre-ELP)	6	Explore expectations and concerns regarding ELP	8
3		2014 (Post-ELP)	9	Explore attitudes towards and experiences of the ELP	8, 9
4		2015 (Pre-ELP)	8	Explore expectations and concerns regarding ELP	8
5	***Phase Two***	2015 (during ELP but Pre-Intervention)	14	Explore the students' experience of the first clinical case study based formative assessment	9
6		2015 (Post-ELP and Post-Intervention)	6	Explore attitudes towards and experiences of the intervention	9

In 2014, another focus group was conducted with a sub-set of the 2014 comparator cohort on completion of the ELP in order to determine if data saturation had been achieved and this session was attended by nine students (Table 3.7, focus group 3). The aim of these two post-ELP focus groups was to explore the participants' experiences of, and attitudes towards, experiential learning in the clinical environment. The questions focused on four main topics: the ease with which students found themselves able to problem solve and apply their knowledge of pharmacology when in the clinical setting; the link between clinical activities performed in the hospital and the clinical analysis of patient cases in the on-campus assessments; the need to formally "teach" students an approach to clinical problem solving and decision making when doing patient case reviews; and suggestions for improved preparation for the move from theory based to practice based learning. A

deductive reasoning approach was then applied to the data collected from these two post-ELP focus group sessions in order to develop the intervention (research objective 9) in 2015.

Pre-ELP focus groups were also conducted with subsets of the 2014 comparator cohort and the 2015 experimental cohort, before the commencement of the ELP (Table 3.7, focus groups 2 and 4). All final year BPharm students in the respective year were emailed an invitation to participate in the focus group in order to: identify both the expectations and concerns of the students prior to their move into the clinical setting of the ELP; explore the student's perception of their level of preparedness to problem solve and apply their knowledge in a patient centred setting; and to identify any changes which could make the transition easier. These focus group sessions allowed in-depth discussions in order to meet research objective 8. The data also informed the development of the content and structure of the intervention in Phase Two (2015).

In 2015, two focus groups were held with subsets of the 2015 experimental cohort, before and after the implementation of the intervention (Table 3.7, focus groups 5 and 6). The same method of purposive sampling using an emailed invitation to the whole 2015 cohort was utilised. The pre-intervention focus group (focus group 5) explored the students' experience of the first formative open book, clinical case study based assessment, and was attended by 14 participants. The data collected was also used in the deductive design approach used for the intervention (research objective 8). The post-intervention focus group (focus group 6) was held on completion of the intervention and ELP, after the Post-Intervention Feedback questionnaire had been administered. The aim of the final focus group was to further explore the students' experience of the intervention in order to meet research objective 9, and involved six participants.

3.7.3 Development and Implementation of the Intervention

Section 3.7.3 describes the development of the intervention and its subsequent implementation (Figure 3.3).

3.7.3.1 Development of the Intervention

The intervention was developed from qualitative data obtained during the three phases of the research, namely the exploratory Preliminary Phase, and the quasi-experimental phases (Phase One in 2014 and Phase Two in 2015) (Figure 3.3).

The qualitative data was obtained from the Pharmacology4 Module Feedback Questionnaire which was administered on completion of the ELP and five focus groups which were conducted, pre- and post-ELP and, prior to the implementation of the intervention after the first Pharmacology4 formative assessment had been written.

As shown in Figure 3.3, data collection commenced during the exploratory Preliminary Phase with the 2013 cohort. The Pharmacology4 Module Feedback Questionnaire was group-administered post-ELP to the 2013 cohort, and again to the 2014 cohort, in order to ensure data saturation had been achieved. The qualitative data obtained from the Module Feedback Questionnaire informed the design of the intervention in 2015, as well as the guiding questions used in the focus groups conducted pre-ELP (in 2014 and repeated in 2015 to confirm data saturation) and post-ELP (in 2013 and repeated in 2014 to confirm data saturation).

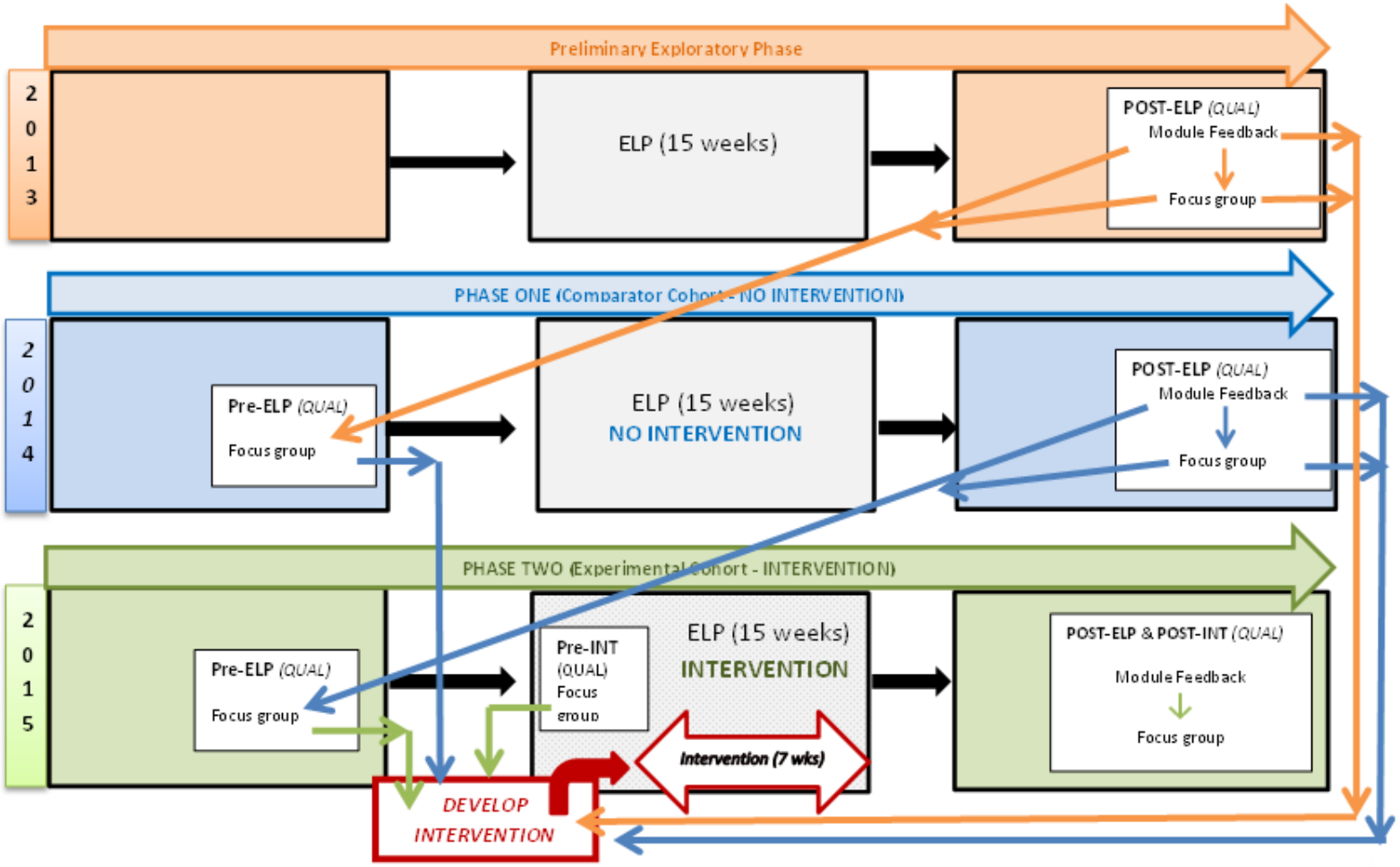


Figure 3.3

The development of the intervention used qualitative data obtained from Pharmacology4 module feedback questionnaire, pre- and post-BLP focus groups and pre-intervention (INT) focus groups. The coloured arrows depict the data from 2013 in orange, from 2014 in blue and 2015 in green, and demonstrate the iterative process used in the design of the intervention.

In Phase Two (2015) a pre-intervention (pre-INT) focus group was conducted after the first formative open book case-study based assessment had been written, in order to identify problems experienced by the students when problem solving and applying knowledge for clinical case study analysis. The pre-INT focus group was held prior to the implementation of the intervention, and the data obtained was utilised in the final development of the structure and content of the intervention. The results and details of the structure and content of the intervention will be presented in Chapter Four, Section 4.3.5.

3.7.3.2 Implementation and Timing of the Intervention

Presentation of the results that culminated in the design of the intervention are included in Chapter Four (Section 4.3.4), as well as the final structure and content of the intervention sessions (Section 4.3.5). The intervention, in the form of supplementary academic support sessions, was designed to run over a seven week period during Phase Two of the research and was introduced at the end of the 3rd rotation of the ELP. By this stage, all of the students had completed a minimum of three weeks in the ELP (i.e. the first orientation week and at least one clinical rotation) and, had written the first formative assessment (based on the open book, clinical case study based format).

The intervention was implemented as academic support sessions which were scheduled for a maximum time period of one hour on a Friday afternoon after the lunch break. Two consecutive sessions were held each week with a maximum of 60 students in each session, in order to encourage and facilitate active participation and discussion within the groups. As scheduled on the timetable, all students attended the one hour ELP report-back session in the morning before the lunch break, where the format involved group-led case presentations of the week's patient case reviews (Chapter Two, Section 1.6.2).

3.8 DATA ANALYSIS

Analysis of both quantitative and qualitative data was required. Quantitative data was captured on a Microsoft Excel® spread-sheet for further statistical analysis.

Following the transcription of the qualitative data from audio recordings of the focus groups and the written responses to open ended questions in the Pharmacology4 Module Feedback Questionnaire and Post-Intervention Feedback Questionnaire, the qualitative data analysis software Atlas.ti® was used to assist in the coding for themes, theme analysis and data management.

3.9 STATISTICAL ANALYSIS

Descriptive and inferential statistics were used for the analysis of quantitative data in order to determine the magnitude of any differences found between and within groups. Statistical analysis of the quantitative data was performed in consultation with a statistician employed by NMMU's Statistical Consulting Unit, in order to verify the appropriateness and accuracy of analytical methods used during data analysis.

Initially, descriptive statistical analysis was computed with the software programme Statistica®, using measures of central tendancy (mean) and variability (standard deviation, range) as well as graphical and tabulated representation of data.

Inferential statistics was computed in order to determine the statistical probability of differences between groups. Statistical significance was considered when $p \leq 0.05$, while Cohen's *d* was used to determine practical significance, based on effect size. The statistical tests utilised included: chi-squared test for baseline comparisons between two groups of categorical data, such as the analysis of incidence data; Student's *t*-test for differences in sample means between two groups of continuous data, where comparisons

between the two cohorts utilised unpaired *t*-test (for independent samples) and comparisons within the cohorts utilised paired *t*-test (for dependent samples); analysis of variance (ANOVA) for differences in sample means across more than two groups; and Pearson's correlation coefficient (*r*) as a measure of the strength of the association between two variables (Walker & Almond, 2010).

3.10 VALIDITY AND RELIABILITY OF DATA

Mixed methods research involves both quantitative and qualitative methodologies and the concepts of reliability and validity of the data collected must, therefore, be considered in both methodologies.

3.10.1 QUANTITATIVE DATA

The widely accepted criteria for validating the quality of instruments used in quantitative research methodologies are reliability and validity (Tashakkori & Teddlie, 2010). Reliability refers to the reproducibility of the data collection instrument, referring to the repeatability of the measurements, while validity is the assessment of whether an instrument measures what it aims to measure (Bowling, 2011). In quantitative research methodologies, both internal and external validity must be shown, as well as the reliability and objectivity of the instruments employed. The following sections consider these concepts when applied to the use of standardised and purpose-designed tests.

3.10.1.1 Standardised Tests

Kolb's LSI is a well-established and widely used standardised test and the reliability and validity of this instrument is well documented (Kayes, 2005). Similarly, Raven's SPM standardised test was originally published in 1938, and has also been extensively used and validated (Raven et al., 2000). The English Reading Comprehension

test was developed and validated for use at NMMU, where it has been used for more than 10 years for evaluating English reading skills in prospective and current NMMU student populations (Foxcroft et al., 2002).

3.10.1.2 The pre-ELP questionnaire

Three data collection instruments were utilised for the questionnaire-based surveys, namely the pre-ELP questionnaire, which used closed questions and collected quantitative data. Qualitative data was collected using open-ended questions in the Pharmacology4 Module Feedback questionnaire and the Post-Intervention Feedback questionnaire (discussed in section 3.10.2). All three questionnaires were purpose-specific and developed by the researcher.

The pre-ELP questionnaire was developed in order to collect demographical information from participants in April during Phase One (2014) and Phase Two (2015), as well as additional information which could not be determined from the other instruments. The pre-ELP questionnaire was developed during the Preliminary Phase of the research (2013) and piloted by dissemination to five final year BPharm students (in 2013) in order to get feedback on the clarity of the questions and general readability of the questionnaire. No amendments were suggested by the respondents, and on examination of the data obtained from the five respondents, the reliability and content validity of the questionnaire was verified (Roberts, Priest, & Traynor, 2006). The standardised pre-ELP questionnaire was disseminated in its current format, pre-ELP, in Phase One (2014) and in Phase Two (2015).

3.10.1.3 Analysis of pharmacology summative assessment papers

Pharmacology2 and Pharmacology3 summative examination papers were reviewed and analysed using the method adopted from Kim et al. (2012), based on the revised Bloom's Taxonomy (L. Anderson & Krathwohl, 2001). The researcher reviewed and analysed the papers according to the approach described in Section 3.7.1 and illustrated in Table 3.3. Another pharmacology lecturer within the department independently analysed the assessment papers, and the researcher then compared the results for consistency in order to verify the validity and reliability of the approach used.

3.10.1.4 Measures of academic achievement

The BPharm weighted average mark for each academic year was calculated from the module marks extracted from NMMU's Business Information System for analysis. The module marks had been entered into NMMU's Business Information System by academic staff, using a dual capturer approach, so were validated at the data capture stage. Pharmacology4 formative and summative assessment marks were also obtained from the database, and again, had been entered using a dual capturer approach, and thus the assessment marks were deemed to be accurate, valid and reliable. The module marks and Pharmacology4 assessment marks would also have been subjected to scrutiny at the relevant marks meetings, when the results were approved and released. The rigorous administrative procedures followed at NMMU were considered to be proof of the credibility of the data obtained.

3.10.1.5 Admission Points Score, BPharm registration code and academic progression

The BPharm registration codes and APS were obtained from the NMMU Business Information system. The information on the Business Information system is verified when captured and subsequently checked by academic and administrative staff. The rate of

academic progression was calculated from the date of first registration for Pharmacology4 and the year of first registration in the BPharm programme, using Microsoft Excel®, and the data used was obtained from the NMMU Business Information System. The procedures followed were considered to be proof of the credibility of the data obtained.

3.10.2 Qualitative data

Researchers continue to differ in their opinions regarding the criteria for validation of the instruments employed for qualitative data collection, where the rigor and trustworthiness of the data must be established. Morse, Barrett, Mayan, Olson, and Spiers (2008) argued that credibility, confirmability, transferability and dependability are more acceptable, rather than the traditional terms of reliability and validity described by Tashakkori and Teddlie (2010). Mays and Pope (2000) argued that qualitative research can be assessed using the concepts of validity and relevance but that application of these concepts will be different when used by qualitative researchers. T. Long and Johnson (2000) supported this viewpoint, adding that the use of alternative terms in qualitative research are often found, on further analysis, to be identical to the traditional terms of reliability and validity. As Golafshani (2003) explained, reliability and validity can be explained as trustworthiness, rigor and quality when viewed from the qualitative researcher's perspective. As defined by C. Anderson (2010, p. 2), "validity relates to the honesty and genuineness of the research data, while reliability relates to the reproducibility and stability of data," when evaluating qualitative research.

For the qualitative components of this mixed methods research project, reliability was established by documenting the procedures followed. These procedures were then reproduced for each focus group session and when analysing open ended questions in the Pharmacology4 feedback and post-Intervention questionnaires. The transcripts were

checked with the original source of data (audio recording or written responses) and verified by an independent research assistant and the same questions were used as a means of checking for data saturation. During theme analysis, lists of codes were created using Atlas.ti®, in order to minimise code drift and codes were frequently cross checked.

When considering validity, Creswell (2009) recommended the use of rich descriptions to convey the findings, prolonged time in the field and triangulation, as possible methods that could be used to establish the accuracy and genuineness of the data. Validity in terms of how well the research tools measured the phenomena under investigation was, therefore, established with the use of direct quotations from the transcripts, enabling the participants' viewpoints and "voice' to be heard. Data were collected over a three year period from three different groups of students, by a researcher with many years of experience with the ELP.

The administration of the Pharmacology4 Module Feedback questionnaire to two cohorts (2013 and 2014) ensured data saturation had been achieved, as no new themes or information was obtained (Babbie, 2010). Data saturation was also achieved by conducting focus groups with subsets of two cohorts, namely pre-ELP (2014 and 2015 cohorts) and post-ELP (2013 and 2014 cohorts). In addition, the mixed methods research design included triangulation of results which is a recognised and widely accepted method of enhancing the validity of qualitative research (Roberts et al., 2006).

3.10.2.1 Focus groups

As described in Table 3.7, a total of six focus groups were conducted. The same procedure was followed for the management of the audio data obtained from each focus group, namely the audio recordings were first transcribed, and the transcriptions checked for accuracy by the researcher. The researcher then used Atlas.ti® to code the

transcriptions during thematic analysis. An independent reviewer received the original audio recordings and was asked to sample and read the transcripts to confirm the accuracy of transcribing. The coding of dominant themes and grouping of themes was also reviewed independently in order to verify the accuracy and trustworthiness of the data obtained.

3.10.2.2 Questionnaire-based qualitative data collection instruments

The purpose-specific Pharmacology4 Module feedback questionnaire (Appendix F) and the Post-Intervention Feedback questionnaire (Appendix G) were developed by the researcher, and utilised open-ended questions in order to collect qualitative data. The Pharmacology4 Module Feedback questionnaire has been disseminated to final year BPharm students at NMMU on completion of the ELP for more than ten years, so a pilot test was not deemed to be necessary, as the questionnaire's reliability and trustworthiness had been established through repeated use. In Phase Two (2015), the Post-Intervention Feedback questionnaire was developed using open-ended questions pertaining to the students' experience of the intervention. The questionnaire was pilot-tested by administering it to five postgraduate students in the Department of Pharmacy. No amendments were suggested and based on the qualitative data provided by the five respondents, the Post-Intervention Feedback questionnaire's reliability and trustworthiness was confirmed. The questionnaire was subsequently administered to the experimental cohort in Phase Two (2015), on completion of the ELP. The handwritten responses were transcribed and Atlas.ti® was used for the theme analysis and coding. The transcriptions were reviewed by an independent reviewer to ensure rigor and trustworthiness of the data analysis.

3.11 SUMMARY OF CHAPTER THREE

Chapter Three focused on the research methodologies employed. The research paradigm of pragmatism was described which provided the framework for this study, as well as the details of the intervention-based mixed methods research design, describing the timing, contribution and nature of the qualitative and quantitative methodologies used during the data collection periods. The study site, study population and sampling methods employed were presented as well as the ethical issues to be considered when conducting educational research. The methods used for data analysis were described, including the evaluation of data for reliability and validity, and the statistical analytical methods employed. Chapter Four will now present the results obtained from the qualitative data, which Chapter Five will focus on the quantitative results. The discussion of the results will be presented and integrated in Chapter 6.

CHAPTER FOUR: RESULTS (QUALITATIVE)

4.1 INTRODUCTION

The results obtained from the qualitative data will be presented in Chapter Four while the quantitative data will be presented in Chapter Five. Interpretation of these results, as well as the triangulation of the qualitative and quantitative data, will be presented in Chapter Six. As described in Chapter Three, section 3.7.2, the qualitative data were generated from two sources:-

a) Open ended questions in the questionnaire based surveys administered on completion of the ELP in all three phases of the research study. The Pharmacology4 Module Feedback questionnaire was administered in the Preliminary Phase (2013) and Phase One (2014), and the Post-Intervention Feedback questionnaire was administered in Phase Two (2015).
b) Focus group sessions which were conducted pre-ELP (in 2014 and 2015) and post-ELP (2013 and 2014) and, before and after the intervention period (INT) in Phase Two (2015).

The qualitative data obtained were then utilised in order to meet two of the research objectives: objective 8 - to explore the students' lived experiences of the ELP in order to describe student attitudes towards and expectations of the clinical placements; and objective 9 - to develop, implement and evaluate an intervention aimed at providing supplementary academic support in the ELP.

Data from the open ended questions in the feedback questionnaires were first transcribed from the handwritten submissions before thematic analysis was performed. The audio data, collected during the focus group sessions, was transcribed before analysis

for dominant themes, using an inductive approach. Atlas.ti® was used for coding and subsequent analysis. All direct quotations from the transcripts will be presented in italic font.

4.2 PHARMACOLOGY4 MODULE FEEDBACK QUESTIONNAIRE

The paper-based Pharmacology4 Module Feedback questionnaire was first administered to participating students on completion of the ELP in the Preliminary Phase (2013). The open ended questions were used to identify the key topics to be explored in the 2013 and 2014 focus groups in order to determine the need for and, the nature of the intervention. The Pharmacology4 Module Feedback questionnaire was also administered at the end of Phase One (2014) in order to confirm that data saturation had been achieved by checking for similarity and repetition in the themes identified, before the design and development of the intervention during 2015 (Table 3.1).

A total of 72 students registered for Pharmacology4 in 2013, 66 students provided written informed consent to participate in the research and of these, 64 respondents completed the Pharmacology4 Module Feedback questionnaire, providing a response rate of 96.97%. In 2014, there were 73 students registered for Pharmacology4, and 71 students provided written informed consent, with 70 respondents completing the module feedback, giving a response rate of 98.59%.

In summary, for the two year period 2013 and 2014, the majority (92.41%) of the total number of students registered for Pharmacology4 (n = 145) provided feedback on the module for the research. The purpose of the module feedback was to encourage students to provide comments and suggestions to the module presenters on completion of the ELP-based module. The Pharmacology4 Module Feedback questionnaire (Appendix G) consisted of three open ended questions:-

Question 1: What aspects of the module did you find to be the ***most difficult***?

Question 2*:* What aspects of the module did you find to be ***most beneficial*** to your understanding and integration of pharmacology?

Question 3: What ***changes*** could be made to improve the current programme which would help future students integrate and apply their knowledge of pharmacology?

Before transcription of the written responses to the open ended questions, an independent research assistant replaced the student number on the questionnaire with a unique study number in order to maintain student confidentiality and ensure anonymity for all respondents. The written responses were then transcribed, checked for accuracy by an independent research assistant and the researcher, before thematic analysis and coding was performed using Atlas.ti®.

Tables 4.1, 4.2 and 4.3 provide the breakdown of the themes identified per question, as well as the frequency of occurrence of the theme and illustrative examples of quotations. All quotations will be presented using the unique study number allocated to the participating student (e.g. participant P4) and the year (e.g. 2013).

Not all of the questions were completed by every respondent, resulting in "no response" to some questions. In some cases, there were multiple responses, which resulted in a greater number of responses than respondents.

Table 4.1
Themes identified in Question One (frequency of occurrence and examples)

THEMES	FREQUENCY OF OCCURRENCE PER YEAR (n)		TOTAL FREQUENCY OF OCCURRENCE %	EXAMPLES OF QUOTATIONS THAT ILLUSTRATE THE THEME
Academic year	**2013**	**2014**	**TWO YEAR PERIOD**	
Number of respondents	n=64	n=70	n=134	
Number of responses*	n=66	n=35	n=101	
QUESTION ONE: Which aspects of the ELP did you find the most difficult?				
Patient case reviews using SOAP approach	18	10	27.72%	*Soap write-ups .. required a lot of time and extensive research skills (P6:2014)*
Open book clinical case study tests	12	15	26.73%	*Open book test .. the practice is not enough (P4:2013); The open book tests .. we need more practice examples before going straight to the tests (P19:2014)*
Identifying medicine related interventions	12	2	13.86%	*Getting interventions was stressful, especially when doctors refuse to agree with you (P18:2013)*
Revision of pharmacology for oral assessments	8	4	11.88%	*Studying for orals due to the workload of the hospital programme and the other modules (P15:2014)*
Group work	4	3	6.93%	*Constantly working in a group with the same people who don't all have the same work ethic (P44:2013)*
Interaction with medical staff	4	0	3.96%	*Interacting with other healthcare professionals. This was difficult because most of them were busy doing their work and did not have time to listen to what we had to say or ask (P23:2013)*
Interaction with patients	4	0	3.96%	*Interacting with patients. Some patients were just not as welcoming. Sometimes it was the language barrier (P23:2013)*
Integration of information	3	0	2.97%	*Being able to integrate knowledge of pharmacology in treatment, especially when there are multiple diagnosis and the patient is on many drugs (P53:2013)*
Adapting to clinical environment	0	1	0.99%	*Adapting to the hospital programme .. it took me longer than expected (P63:2014)*
Lack of clinical supervision by pharmacists	1	0	0.99%	*Getting enough contact with coordinator (P21:2013)*

**Note:* When more than one theme was identified by the respondent, all of the themes were included, resulting in a larger number of responses than respondents.

4.2.1 Question One

The first question invited respondents to identify the most difficult aspect of the ELP (Table 4.1), and 101 responses were received. The written patient case reviews (27.72%; *n* = 101) and the open book clinical case study-based tests (26.73%; *n* = 101) were most frequently identified as difficult by the students. Prior to the ELP, the students had utilised the SOAP approach when analysing simulated clinical cases in BPharm3 practical sessions, so the finding that so many students identified this aspect of the ELP as difficult was unexpected. A few of the students felt that the difficulty experienced with the patient case reviews was the result of the amount of time spent working as a group in order to finalise the write-up.

> *The submission of SOAPS was time consuming and required extensive research to be done. However, this helped me in linking pathophysiology to pharmacology. (P13:2013)*

Conflict within the groups was mentioned by several students, suggesting that some of the difficulties experienced were interpersonal, rather than the patient case review itself, as illustrated by this participant's observation. Seven of the students identified group work as problematic (Table 4.1).

> *Working in groups is hard because everyone has their different way of doing things but it also helped to get different perspectives. (P23:2013)*

One respondent elaborated further that the difficulty was in fact due to the need to integrate information, which was identified as a theme by three participants (Table 4.1). The high frequency of occurrence of the theme of patient case reviews was similar to that of the theme of open-book clinical case study-based tests. Many students identified a need for more practice at this type of assessment, explaining that the written patient case reviews were not equipping them with the skills required for the assessments. However, both

activities involved analysis of clinical cases and, therefore, require the student to apply knowledge and integrate information, something that the students appeared to struggle with at this level. The need to identify medicine related interventions when reviewing patient cases in the clinical setting was also identified as problematic (13.86% of responses). This appeared to be linked to poor inter-professional communication skills as well as an inability to integrate and analyse clinical information for individual patients.

Finding interventions … especially in the neurology ward. (P30:2014)

Looking for interventions was difficult and time consuming. (P45:2013)

The need to revise pharmacology was also mentioned as difficult (11.88%; *n* = 101) in that students felt they did not have enough time to do this revision. This was in spite of the fact that students were automatically reviewing their pharmacology as they completed the various clinical activities in the hospital environment.

The workload for the pharmacology orals is ridiculous and some weeks have too many topics to read through. (P60:2013)

4.2.2 Question Two

The second question asked students to identify the components of the ELP which enhanced their ability to understand and integrate their pharmacology. A total of 159 responses were recorded because when more than one theme was identified by the respondent, all of the themes were included. The exposure to the clinical environment was identified by many students (26.42%; *n* = 159) as the most beneficial component that encouraged a better understanding of pharmacology (Table 4.2).

Table 4.2
Themes identified in Question Two (frequency of occurrence and examples)

THEMES	FREQUENCY OF OCCURRENCE PER YEAR (n)		TOTAL FREQUENCY OF OCCURRENCE %	EXAMPLES OF QUOTATIONS THAT ILLUSTRATE THE THEME
Academic year	**2013**	**2014**	**TWO YEAR PERIOD**	
Number of respondents	n=64	n=70	n=134	
Number of responses*	n=100	n=59	n=159	
QUESTION TWO: Which aspects of the ELP were most beneficial to your understanding and integration of pharmacology?				
Being in the clinical environment (the ELP)	23	19	26.40%	*Spending time in the wards choosing cases, talking to the doctors and nurses and seeing pharmacy in practice. (P9:2014)*
Patient case reviews (SOAP approach)	22	18	25.20%	*SOAP write-ups really took my pharmacology knowledge to a new level. Applying the work was the most interesting for me.(P14:2013)* *SOAP analyses helped me break down clinical problems and apply knowledge. Very, very beneficial, with more SOAPS, there was more learning.(P31:2013)*
Application of knowledge	14	7	13.20%	*Applying the pharmacology learnt in the other years to the work environment (P66:2014)*
Screening patient files	14	5	11.90%	*By actually screening patient files to analyse their medication ..really enhanced my ability to integrate and utilize my pharmacological knowledge.(P22:2013)*
Interaction with medical staff	10	4	8.80%	*The hospital rounds and the interaction with the different health professionals was very inspiring and resourceful (P43:2013)*
Case presentations by fellow students	7	4	6.90%	*Friday feedback session was very useful in terms of learning different cases that students can access while at the hospital. (P59:2013)*
Identifying medicine related interventions	9	2	6.90%	*Finding intervention as this gives a good feel of what a pharmacist really does in hospital.(P9:2013). The fact that I had to screen patients, critically evaluate their therapy and find interventions enable me to dig deeper into my pharmacology (P37:2013)*
Open book clinical case study tests	1	0	0.60%	*Open book tests also allowed us the opportunity to apply the knowledge. (P14:2013)*

**Note:* When more than one theme was identified by the respondent, all of the themes were included, resulting in a larger number of responses than respondents.

The actual time spent in the hospital … I have learnt so much about pharmacology and clinical scenarios this year. (P17:2014)

Actually screening patient files to analyse their medication, as well as going on ward rounds with other healthcare professionals enhanced my ability to integrate and utilise my pharmacological knowledge. (P22:2013)

Everything I learnt during my hospital rounds was beneficial to me, since I was able to learn and put into practice what I've learnt from theory lectures. (P38:2013)

Hospital visits and the ward rounds. This was really awesome. It opened my mind on many issues of clinical practice. I learnt a lot. It urged me to read on things I encountered that I did not understand. (P55:2013)

Although the written patient case reviews were identified as the most difficult aspect in Table 4.1, this theme was also identified as the most beneficial aspect for understanding and integrating pharmacology (25.2%; *n* = 159) (Table 4.2), as explained by the following three participants.

Writing the SOAPS – this just broadened my knowledge as a lot of research has to be put in. (P23:2013)

SOAP write-ups helped a lot in understanding various medical conditions and linking different chapters we learnt. (P24:2013)

SOAP write-ups were beneficial in the ward rounds because it helped you apply your theoretical knowledge to practice. (P18:2014).

Students also identified the application of knowledge (13.2%; *n* = 159) and screening patient files (11.9%; *n* = 159) as beneficial to their learning, and recognised the learning potential of the clinical activities.

The hospital programme … really took my pharmacology knowledge to a new level, and applying the work was the most interesting for me. (P14:2013)

I enjoyed the hospital programme because we practically applied our knowledge. (P54:2014)

Screening … made me take a closer look at drug therapy. (P14:2014)

I had to screen patients, critically evaluate their therapy and find interventions ... this enabled me to dig deeper into my pharmacology. (P37:2013)

The interaction with other healthcare professionals was highlighted as a positive learning experience (8.8%; *n* = 159).

Ward rounds, although I attended only a few, I found them very beneficial. (P15:2013)

Listening to peers' presentations of patient case reviews was also identified as a valuable learning tool (6.9%; *n* = 159).

The groups presenting … I have learnt a lot by listening to what the other groups are doing. (P63:2014)

4.2.3 Question Three

The themes from the last and third question are shown in Table 4.3. This question invited suggestions for possible improvements in the ELP. Only a few recommendations were made as only 44 responses were received. The majority of the students left this question blank or commented that they felt the ELP did not require any changes.

I think it is fine the way it is. (P46:2013)

The programme is perfect as it is. (P39:2014)

It is a fantastic programme, good job to the pharmacy lecturers. (P56:2013)

Spending more time in the clinical environment was the most commonly encountered theme (43.2%; *n* = 44) and was supported by recommendations that the ELP should be started in the BPharm3 year (27.3%; *n* = 44).

> *Starting hospital programme in 3rd year as it helps [you] apply knowledge. (P30:2013)*

> *More time in the hospitals. (P50:2013)*

> *More time in the ward rounds would be ideal. (P32:2014)*

More practice at analysing clinical cases was also suggested (18.2%; n = 44), implying that the students still struggled with the integration of clinical knowledge when problem solving.

> *More cases should be analysed practically, looking at what is being done in practice. (P21:2014)*

> *Examples should be done in class ... as the first weeks were difficult. (P26:2013)*

> *Open book tests should be started earlier to practice more. (P30:2013)*

Overall, the feedback on the ELP was positive, as illustrated by the following four comments:

> *The course itself was excellent and I enjoyed it. It equipped us with a lot of information, things which were not known to me. The course was well presented. (P52:2013)*

> *Mostly I would like to say it has been a very good programme and I have learnt a lot from it. It brings the perspective of pharmacology from 2nd year to the final year. It helped me link and apply my pharmacology. It also helped me to be up to date with my pharmacology. (P34:2013)*

Table 4.3
Themes identified in Question Three (frequency of occurrence and examples)

THEMES	FREQUENCY OF OCCURRENCE PER YEAR (n)		TOTAL FREQUENCY OF OCCURRENCE %	EXAMPLES OF QUOTATIONS THAT ILLUSTRATE THE THEME
Academic year	**2013**	**2014**	**TWO YEAR PERIOD**	
Number of respondents	n=64	n=70	n=134	
Number of responses	n=33	n=11	n=44	
QUESTION THREE: Can you suggest anything that could improve the ELP?				
Spend more time in the clinical environment	17	2	43.20%	*Encourage the students to embrace the time in the hospital to grasp the concepts and learn. This helps in the open book exams (P9:2014)*
Introduce clinical exposure in hospitals earlier	7	5	27.30%	*Employ it earlier in the degree course as it helps students who understand information better by actively witnessing it & putting it into practice (P19:2013)* *Starting hospital programme in 3rd year as it help applying knowledge. (P30:2013)*
More practice at analysing clinical cases	4	4	18.20%	*Open book tests are a huge leap from 3rd year level to 4th year. (P35:2013)* *More cases should be analysed practically - looking at what is being done in practice (P21:2014)*
More clinical supervision	5	0	11.40%	*Increase number of supervisors at sites by at least 2 (P5:2013)*

I enjoyed the hospital programme because we practically applied our knowledge. (P54:2014)

Very invaluable in gaining knowledge and experience (P51:2014)

4.2.4 Summary of the key findings from the Pharmacology4 Module Feedback

In summary, the results of the Pharmacology4 module feedback in 2013 and 2014 identified key topics and some areas of concern, namely that many students struggled with the patient case reviews and the case study-based tests, as well as the identification of medicine-related interventions and integration of clinical information, all of which require application and integration of knowledge. In addition, interaction with healthcare professionals and patients appeared to be problematic for some students. Many of the students suggested that the ELP and exposure to the clinical environment should occur earlier in the BPharm programme, implying that the preparation completed in BPharm3 modules was inadequate in preparing students for the ELP. The key topics that were raised and the areas of concern were then used to guide the focus group discussions with the purpose of further exploring the expectations and lived experiences of the students in order to understand where additional academic support could be introduced. The results of the focus group discussions will be presented in the next section.

4.3 FOCUS GROUPS

4.3.1 Overview

The aim of the focus group sessions was to explore the students' expectations and lived experiences of experiential learning in the clinical environment and, to guide the development of an intervention in the form of supplementary academic support. A total of six focus groups were conducted over the research period. The purpose and timing of the

focus groups differed, as previously explained in Chapter Three (Table 3.7). The results of these six focus groups will now be presented in three different sections, namely:-

- Section 4.3.3: the students' expectations and experience of the ELP
- Section 4.3.4: the design of the intervention,
- Section 4.3.5: the students' experience of the intervention.

4.3.2 Conducting the focus group sessions

The method of recruitment for the focus group sessions and the procedures that were systematically followed during each session were described in detail in Chapter Three (Section 3.7.2.3). For the purpose of presenting these results, each participant in the focus group was assigned an alpha-numeric code in order to preserve participant confidentiality. This code will be the only identifier used when including direct quotations from the transcriptions. The code represents the participant number (e.g. P4), the specific year (2013) and whether the focus group was conducted before or after the ELP (pre- or post-ELP) or, before or after the intervention (e.g. pre- or post-INT).

4.3.3 Students' Expectations and Experiences of the ELP - Analysis of the Focus Group sessions

Four of the six focus group sessions were aimed at exploring the students' expectations and experiences of the ELP (Table 4.4). The remaining two focus groups were held before and after the intervention, and will be discussed in sections 4.3.4 and 4.3.5.

Table 4.4
Demographic detail of focus group participants

	Pre-ELP		**Post-ELP**	
	April 2014	April 2015	Oct 2013	Oct 2014
Number of participants	6	8	10	9
Gender of participants				
Male	2	4	6	1
Female	4	4	4	8
Duration of focus group	40 mins	2 hrs 20 mins	1 hour 41 mins	1 hour 24 mins

The topics that were used to guide the discussions were:-

Pre-ELP: The students' expectations and concerns were explored before commencing the ELP, as well as their perceived level of preparedness for application of knowledge in the clinical setting.

Post-ELP: The students were asked to retrospectively reflect on their experiences of the ELP, and to identify any difficulties encountered, as well as their perceptions of the value of clinical activities as preparation for the written assessments. Suggestions were also invited regarding possible improvements in the preparation for the move from theory based to practice based learning.

The results will be reported according to the emerging themes that were identified during analysis (Table 4.5). Due to the fact that similar themes emerged during the pre- and post-ELP discussions, the results for each theme will include both the pre-ELP data as well as the students' retrospective reflections on completion of the ELP (post-ELP data).

Table 4.5
Themes identified during analysis of pre- and post-ELP focus group data

Clinical environment
Inter-professional relationships and professional identity
Integration of knowledge and application to patient care
Self-perceived level of preparedness

4.3.3.1 Clinical (Hospital) Environment

The expectations of the students prior to commencing the hospital-based ELP were found to be realistic as well as positive, as students expressed an interest in exposure to hospital pharmacy as a future career option.

> *I haven't been in a hospital environment before and I (would) also like to become a hospital pharmacist as well. (P1:2014:Pre-ELP)*

> *It's a new environment, so it helps us to see how things work in the hospital. People may be interested in hospital work one day or clinical pharmacy, so it broadens that perspective. (P3:2015:Pre-ELP)*

Students generally looked forward to the opportunity to apply their knowledge in the patient-centred setting of a hospital.

> *The hospital programme will provide us with an opportunity to pull everything together and look at a holistic approach to the pharmacological management of the individual. (P2:2015:Pre-ELP)*

> *To be able to learn a lot more and gain experience - being able to apply what we've learnt to what we actually have to do. (P5:2014:Pre-ELP)*

Several students expressed anxiety at the responsibility that accompanies patient involvement, and appeared to experience feelings of apprehension and nervousness.

Moving from listening to my lecturer and actually making decisions … just moving from the fact that we were babied in class and now we have to be independent individuals. I think it's going to be quite daunting. (P1:2014:Pre-ELP)

You are responsible – will you be able to be ready? Will you be responsible to be in charge of another person's life? (P5:2014:Pre-ELP)

I don't think I am prepared enough … we need to go through all our pharmacology notes and carry that with us to the hospital for application. (P2:2015:Pre-ELP)

Having to learn the skills that are applicable in the hospital setting in terms of having to learn how to read the doctors' writing and not make mistakes and in terms of having to know exactly when there's a drug interaction. (P6:2014:Pre-ELP)

On completion of the 15 week programme, when retrospectively reflecting on the ELP, the majority of students described a feeling of being overwhelmed by the amount of clinical information in the medical file, admitting that they didn't know where or how to start working through this information and how to integrate the clinical notes, prescribed medication and laboratory tests. In addition, most of them expressed frustration as they struggled to read the doctors' handwriting as well as the frequent use of medical abbreviations which were often context-specific, making interpretation difficult. There was a genuine fear of making a mistake by overlooking important information in the clinical notes as illustrated in the following two observations:

The biggest challenge when I started, was how to find information in the patient file, because it was so large and there were a lot of things in there … most of the times, reading the doctors' handwriting was actually a challenge. (P5:2013:Post-ELP)

I have been working [in community pharmacy] since second year and I feel very confident. I feel confident when I'm talking to patients and even when I'm standing

in front of the doctor that's coming in for medication but I just felt very overwhelmed with the [hospital] environment. (P3:2013:Post-ELP)

Pharmacists typically tend to be very organised and work well in a structured environment and several students described how they found the move into this unfamiliar, less structured and at times chaotic or noisy environment, overwhelming and unsettling.

In class, everything is organised. I'm an organised person. You've got your script, you store it on the computer, you put it in a file and it is filed later on. Everything has its book, everything has its file and then you come to the hospital and everything is in one file and the doctors are running around and the nurses are running around … so it's not organised like what we used to. (P3:2015:Pre-ELP)

On completion of the ELP, students realised that their ability to integrate all the relevant clinical information in a meaningful manner had definitely improved with time and repeated exposure, as they became more familiar with the hospital environment and structure of the medical files, and started to integrate the clinical information, as explained by this participant:

You're going straight to the blue chart [prescription medicine] but if you actually go through the doctors' notes, and you read them according to the day, you can see this drug was started on this day and you look at the day before's notes and you can actually see a reason as to why - it just makes so much more sense. (P2:2014:Post-ELP)

Several students voiced their initial anxiety and nervousness at having to approach the patient.

I was a bit worried about the language barrier in terms of communicating with the patients. I wasn't confident in that area. (P8:2013:Post-ELP)

I think some people [students] are quite apprehensive on how to approach a patient. We had a lady who pulled the blanket over her head and she didn't want to speak to anyone. There might be a language barrier. They might just not actually not want to speak to you. You walk into that ward and you stand there and, everyone's looking at you, and you're like, where do I go? Who do I talk to? How do I do this? (P1:2014:Post-ELP)

When we stand in retail, they [the patients] come up to us. They come and tell us their problems; we don't have to delve into what's going on, so it's much easier. (P1:2015:Pre-ELP)

Students later described how their confidence developed with repeated exposure to this activity.

But as time went by, I became comfortable. (P8:2013:Post-ELP)

You have more contact with the patient and with the rest of the staff [and] it makes it so much easier. (P6:2014:Post-ELP)

4.3.3.2 Inter-professional relationships and professional identity

Before the ELP commenced, the majority of students expressed anticipation and interest in working with other healthcare professionals, identifying nurses and medical doctors as healthcare professionals that they looked forward to interacting with for the first time.

I'm looking forward to working with the other healthcare professionals because in the [community] pharmacy, you are mostly focused on working with the pharmacist or assistant and, if you're lucky, there's a nurse, so I'm really looking forward to working with the doctors and the other nurses and the physios. (P6:2014:Pre-ELP)

However, students found that the reality of entering an unfamiliar clinical environment proved to be more difficult than expected.

You need to get familiar with your surroundings. That was the scariest part, going into it [the ward], because now you're nervous and the [nursing] sisters are looking at you. What are they going to think if I say something to them. (P1:2014:Post-ELP)

I wasn't sure if the nurses or the staff would be too receptive of my concerns and questions, so at times I would hold back and I would not ask questions. (P1:2013:Post-ELP)

On our very first ward round, we were encouraged to ask questions and then I asked Dr about an antibiotic and he completely took my head off. So I think that was a bit of a strike to the confidence. You're very hesitant to ask questions after that. (P2:2013:Post-ELP)

The majority of students expressed a fear of questioning a doctor's clinical decision regarding medication-related issues. The doctor was seen as the ultimate authoritative figure who should not to be questioned. The following two quotes describe the viewpoint of the participants:

In first year, second year, third year and fourth year, I meet my lecturers and they are so knowledgeable, so now when I go into the hospital, I see a doctor and somehow I just link the doctor to my lecturer. So I've never in the past three years told a lecturer that they've made a mistake, so it's always been this submission thing that's been there, and all of a sudden I have to jump out of this shell. (P10:2013:Post-ELP)

The one thing which I find a bit difficult … was to speak up and try and question the doctor, because I'm used to the lecture environment whereby I get given the work, I study and then I write the test I've got no right or place to question what he's [the medical doctor] is doing. (P7:2015:Pre-ELP)

Several students added that they found it much easier to interact with the medical interns than the more senior doctors.

It was a lot easier for us to approach the interns, because the interns were more or less our age ... once you speak to a couple of doctors, you find out they actually want you there, they want you to help, they want you to pick up interventions, because it also benefits them. (P4:2013:Post-ELP).

A lengthy discussion revolved around the role of the pharmacist in the clinical setting. A feeling of inferiority and a lack of confidence was expressed and discussed at length, with participants identifying a perceived lack of knowledge, possibly stemming from a poor professional identity in the hospital context.

Sometimes I feel as though the pharmacy profession is not taken into consideration because a lot of people think that we just dispense drugs. (P6:2014:Pre-ELP)

He [the doctor] has seen the whole view of the patient and I am just looking at the drug side effects, so I feel that my knowledge is in comparison, very minute to what he does, so I can immediately put him up there and then I'm like, can I really question him? (P7:2015:Pre-ELP)

I've been called a glorified pill counter (laughing) ... why don't you have an electronic pill counter? That lady from the Nursing Department called us medication specialists and that made me feel a little less inferior, because we do know the medication. The doctors know the diagnosis and some medications and the nurses know the caring. Everybody should work together, you know your field, you specialise in your field and you should all work together. (P3:2015:Pre-ELP)

One participant disagreed vehemently with the group and proudly shared her feeling of confidence in her ability. She was a mature student in terms of age and had worked in a pharmacy environment before coming back to study. Her self-confidence and strong professional identity was in stark contrast to the rest of the students:

I don't feel inferior at all. Not at all. I have studied medicines for four years, I am a specialist in the field of medicines and I'm so confident about that. I have been taught at NMMU and I am not ashamed of anything. (P5:2015:Pre-ELP)

This insecurity about the pharmacist's role diminished as the students' clinical skills improved and they became more familiar with the environment:

> *The doctors asked us about a patient who had a problem with her warfarin ... she was on 10 mg a day, and her INR was still under 2 and he's like, is there an interaction going on between these? So ... there was a possible interaction, but there's nothing you can really do about it. You just have to increase her dose. That makes you feel so useful in the ward, he [the doctor] was like, pharmacists you know this and he asked us and it was really rewarding to have that. (P1:2014:Post-ELP)*

4.3.3.3 Integration of knowledge and application to patient care

Before the start of the ELP, the students described a general lack of confidence in their level of pharmacology knowledge and their ability to verbalise and apply this knowledge:

> *In class, if you study something, you have time to recall, what you want to know … but now in the hospital, you've got to think on your feet. If somebody asks you something, you must be able to answer. If you get a drug class wrong, that's a problem. (P3:2015:Pre-ELP)*

> *The most frightening thing is the fear of making a mistake … knowing when you are making the right decision or the wrong decision. (P2:2014:Pre-ELP)*

This lack of confidence appeared to stem from a feeling that students lacked integration of their knowledge. Several students also felt that the assessments in Pharmacology2 and Pharmacology3 were not integrated, which negatively affected their ability to integrate and apply their pharmacology:

> *Often we learn topics in isolation and we forget to link everything together ... I think the main problem is trying to realise that pharmacology cannot be studied in isolation but needs to be integrated. (P2:2014:Pre-ELP)*

When we start doing pharmacology in second year we are taught things like topic per topic and that somehow trains you to think separately … you grow to think that way, like okay, this is antibiotics, this is antidepressants, and, then you come to fourth year and you have to put everything together, so now you also have to learn how to integrate everything in such a short time. (P8:2013:Post-ELP)

I think it would be nice to integrate questions more from different sections, 'coz I think it also wakes people up that you can't study pain by itself. (P1:2015:Pre-ELP)

Several students described a lack of confidence in their ability to identify medication-related problems as they struggled with the apparent conflict between what they had been taught in lectures and how patients were actually managed in practice.

Warfarin and aspirin, those shouldn't go together, but then you get a case and the doctor says no, they have shown how beneficial that is. So it's also drug interactions and you get CYP450 inhibitors that you think, oh no, don't put those two together, but they [the medical doctors] like to put those together, so it doesn't always match up. (P9:2014:Post-ELP)

For me it was when I went to the hospital, I just consulted my TB guidelines and I thought everything had to be done according to that, so we got to see a patient with TB meningitis, so then the doctor says no, that's just a recommendation. (P5:2013:Post-ELP)

However, when reflecting on their ability to integrate and apply knowledge when looking for medicine-related problems in the clinical setting, the participants were able to identify how this clinical skill developed and improved with time as they grew in confidence and became familiar with the new environment. This really reinforced the need for repeated exposure which encourages learning by repetition:

As the programme went on, you became so accustomed to the files, to the patients, to the drugs, that you just pick it up so much more quickly than you were in the

beginning. You actually realise the importance of having to do it, because you start finding interventions that are really beneficial to the patient, where the doses might be wrong or they are using the wrong drug. (P4:2013:Post-ELP)

You're in the ward, you're seeing the problems, you're speaking to the doctors about the problem, getting the drug changed, you're fixing issues and now I will never forget that that drug has a problem with this [drug] and needs to be changed. (P2:2014:Post-ELP)

On completion of the ELP, two participants described how they found the discussions with medical doctors were a beneficial and positive learning experience, which also appeared to reinforce the pharmacist's role in this clinical setting:

What really helped me was going on rounds with the doctors, where you have the opportunity to be asked a question. So my first hospital round was bad but then I went home and I started studying for the subsequent ones, so my second hospital round was fabulous because I was able to be on a par with the doctors and I was happy and it really helped me. (P9:2013:Post-ELP)

We went on a hospital round at least once a week with the doctor ... so we would meet the doctor and we could introduce ourselves and then we would go patient to patient with the doctor ... it also helped us develop confidence in speaking to the doctor and asking questions. (P3:2013:Post-ELP)

All of the participants confirmed the usefulness of the weekly structured clinical activities and tasks completed during the ELP although personal preferences were expressed. The screening of medical files for medicine-related interventions and detailed patient case reviews were named by the majority of participants as the most useful learning activities.

With the screenings, you're seeing all those drugs so close together and you get used to linking them and seeing okay, these drugs together, that condition, these drugs together, that is another condition. (P2:2014:Post-ELP)

Towards the end, I didn't really have to search for interventions. I realised that the way to find the interventions was that I had to carefully go through the file [screening] and then as I did that, then I realised that you would easily get interventions. (P5:2013:Post-ELP)

The SOAP [patient case review] definitely helped you put everything together, to make it, complete, to close off on a topic and on a disease state, because you have multiple drugs, multiple conditions that you just link and how important it is to monitor your labs [laboratory investigations]. (P3:2013:Post-ELP)

4.3.3.4 Self-perceived level of preparedness

At the start of the ELP, the majority of participants felt unprepared and expressed concern that their pharmacology knowledge was inadequate due to a lack of integration of content (as mentioned previously). A few of the participants identified the simulated clinical case scenarios in second and third year pharmacology practical sessions as useful preparatory exercises:

I think I learnt better with simulated pracs, than actually just learning from my notes and then having to think of how I would apply this to a patient. (P1:2014:Pre-ELP)

However, when reflecting on the integration of knowledge that should have accompanied these practical sessions, several students pointed out that this did not always happen, explaining that work was divided between group members in order to complete the practical session quickly.

For me, it didn't ... in my group, everyone was ... you do side-effects, you do mechanisms, we never got to sit down and discuss the problem. We did not relate the drugs or the case to each other. (P1:2013:Post-ELP)

The externship hours done in community pharmacy settings were not perceived as adequate preparation for the clinical rotations, with many of the participants expressing frustration with the lack of direct involvement with patient care.

> *In the beginning, the pharmacists don't really want to train you and you don't really know how to work on the [computer] system - so all you have to do is count out stock or pack stock … you are just dispensing drugs but you never really interact with patients or have the opportunity to intervene with patients. (P5:2014:Pre-ELP)*

> *When you start counselling someone, they just say no, I know this, just give me the medicines and then they can leave. (P2:2015:Pre-ELP)*

> *In community [pharmacy] all you have is the prescription and you don't have the clinical picture, whereas in hospital, you've got the medical file as well as the prescription - and the diagnosis. (P4:2014:Post-ELP)*

However, a few students acknowledged that their externship hours in community pharmacy had equipped them with skills such as multi-tasking, task prioritisation and communication. These skills were discussed at length, as the students voiced their expectations that these skills would also be useful during the ELP, when they reviewed medical files and participated in ward rounds and completed the various clinical activities that were required. They also explained that the externship hours had developed their confidence when communicating with patients and medical doctors:

> *I think to be a pharmacist, you need to be able to answer a phone, be speaking to a person, have a screen open here and have someone shouting at you because the queue is long. I think you need to be able to balance a whole lot of things. (P1:2015:Pre-ELP)*

> *I think that's what retail [community pharmacy] taught me. To be more confident with patients and doctors and other pharmacists (P4:2014:Pre-ELP)*

4.3.3.5 Summary of the focus groups (students' expectations and experiences of the ELP)

The results presented in section 4.2, obtained from the Pharmacology4 module feedback questionnaire, highlighted key areas that were explored further during the focus groups. The results presented in section 4.3 were obtained from the pre- and post-ELP focus groups and provided rich and detailed insight into the students' expectations and lived experiences of the ELP.

The dominant themes that emerged during analysis of the discussions were:-

- Students experienced difficulties as they entered the clinical environment. Many identified a feeling of being overwhelmed by the volume of clinical information that they had to work through and a lack of confidence in their knowledge and ability. Several students complained that they didn't know where or how to start working with all the clinical information as they started to review patient medical files. The much anticipated interaction with the rest of the healthcare team did not always live up to expectations, and communication with patients was also often difficult to initiate.
- Apprehension with respect to the integration and application of knowledge was a theme identified by many students prior to the commencement of the ELP. This apprehension proved to be valid as these clinical skills were found to be a stumbling block for many students, who described their struggle with the detailed patient case reviews and clinical case study based open book assessments, as well as the need for more practice and support in analysing clinical cases. A few students experienced a growing self-confidence as their clinical skills improved over the duration of the ELP.

- Many of the students expressed a lack of confidence in the clinical setting, and surprisingly seemed to be unsure of the role and functions of the pharmacist in this environment, leaving them with a sense of inadequacy. This was aggravated by a feeling of inferiority, which initially hampered interaction with the medical doctors and nurses. With time, some students experienced positive inter-professional interaction which clarified and confirmed the professional role and identity of the pharmacist in the provision of pharmaceutical care in the hospital setting.
- The majority of students felt unprepared for the move from the theory-based lecture environment, to the clinical setting where they needed to apply knowledge. The preliminary practical work completed in BPharm3 modules as well as the externship hours completed in a community pharmacy setting was perceived as inadequate preparation for the academic demands of the ELP. The majority of students highlighted the educational value of the detailed patient case reviews as well as the daily screening of medical files, explaining that these clinical activities enhanced their ability to apply and integrate knowledge.

4.3.4 Development of the Design of the Intervention - analysis of focus group sessions

The intervention was developed in the format of supplementary academic support sessions, using qualitative data collected from the post-ELP Pharmacology4 module feedback questionnaire administered in the exploratory Preliminary Phase (2013) and Phase One (2014) (Chapter Three, Section 3.7.2.1) to identify the key areas and questions for the focus group discussions. Qualitative data was obtained from the four pre- and post-ELP focus groups. During Phase Two of the research study (2015), a focus group was held after the first open book clinical case study based test (i.e. pre-intervention) in order to

describe and further explore the students' first experience of this assessment method, which evaluated problem solving and clinical decision making skills. Once the qualitative data had been analysed, the intervention was designed and subsequently implemented in Phase Two during the ELP, in the form of supplementary academic support sessions (section 3.7.3). The sixth focus group was conducted post-ELP in 2015 (Phase Two) in order to evaluate the intervention through exploration of the students' experience of the intervention, and the results will be presented in section 4.3.5.

Thus, the intervention was developed using the qualitative data from five different focus groups. The method of recruitment of participants and the procedures followed during the focus group sessions were described in Chapter Three, Section 3.7.2. The audio transcripts were transcribed before thematic analysis, using Atlas.ti®. The results will be presented according to the dominant themes that emerged during analysis, as these themes contributed to the structure of the intervention. Results will be illustrated with quotations by the participants, using the code described previously, i.e. the participant number (e.g. P4), the specific year (2013) and whether the focus group was conducted before or after the ELP (Pre- or Post-ELP) or before the intervention (eg Pre-INT). The demographic characteristics of the focus group participants, and the duration of the focus groups, are shown in Table 4.6.

Table 4.6
Demographic detail of focus group participants

	Pre-ELP		**Post-ELP**		**Pre-INT**
	April 2014	April 2015	Oct 2013	Oct 2014	July 2015
Number of participants	6	8	10	9	17
Gender					
Male	2	4	6	1	4
Female	4	4	4	8	13
Duration of focus group	40 mins	2 hrs 20 mins	1 hour 41 mins	1 hour 24 mins	1 hr 28 mins

The dominant themes identified during the analysis of the five focus groups are listed in Table 4.7 and the results of these discussions will be now presented under each theme.

Table 4.7
Themes identified which contributed to the Design of the Intervention

Integration of clinical information
Group work
Active participation

4.3.4.1 Integration of clinical information

One of the dominant and recurrent themes that emerged during the discussions was related to the application of knowledge and integration of clinical information. This was identified by the students as problematic when analysing patient case reviews and identifying medication-related interventions in the clinical environment as well during the open book clinical case study-based assessments.

Clinical environment

Several of the students expressed a feeling of being overwhelmed with the amount of information in the medical files, complaining that they didn't know how or where to start working through the relevant information in order to conduct a medication review. This finding was unexpected in light of the externship hours spent in community pharmacy, where students evaluate prescriptions as part of the dispensing process, as well as their previous exposure to simulated clinical case scenarios in BPharm3 practical sessions.

The biggest challenge when I started was how to find information in the patient file, because it was so large and there were a lot of things in there, so I didn't know where exactly I was supposed to find information. (P5:2013:Post ELP)

At first ... we didn't even have a plan, we would just go to the wards and sort of look at the files and check the treatment and just sort of look at the diagnosis, look at the treatment, you just sort of write down the treatment on the screening notes. (P4:2014:Post ELP)

As you go through the file, you didn't know how far to look back for information, and how far forward to look into the patient's file ... At times we would be screening only at the blue board [prescription medication] and not going through the patient file … so you kind of like, okay, this one was given this but why? You don't even know how to begin, you are looking at this patient's file and you can only see a bunch of tests. (P1:2013:Post ELP)

So there were times when you're looking and you're looking and you don't know what's important and what's relevant and are you taking too much information or too little information. (P3:2013:Post ELP)

Three students were able to describe a more structured approach and their ability to link and integrate the information in the medical file. This ability appeared to have developed with repeated exposure and practice, as illustrated by the following comments.

When we first went into the hospital programme, like, the first few times, it is difficult to pick up problems because you are not used to it but you kinda get used to that process as you go along in the programme. It was a lot easier at the end than it was at the beginning ... as soon as you see a drug and you see another drug, you're like oh, those two are like ... there's a red flag. (P2:2014:Post ELP)

Later on, we found out that when you are looking for interventions, you must look at the treatment [medication], look at the diagnosis, and try to link these two together. (P4:2014:Post ELP)

Going through the charts and oh look, the blood glucose was really high on this day and then they gave [this drug] and, you know, it came down ... to actually see the effect of the drugs rather than, okay, the patient's on this drug. (P2:2014:Post ELP)

Many students struggled with the contrast between the approach to pharmacology in the lecture environment and the application of pharmacological knowledge in the clinical setting, as described by this participant.

If you ask any second year pharmacy student, what is pharmacology all about, they will say the mechanism of action ... but when you get into practice, you realise that … what you are really looking out for are multiple side-effects in a patient and you are looking out for contraindications, and can they really use this drug? (P10:2013:Post ELP)

Most of the students requested more practice at analysing cases in preparation for the open book clinical case study-based tests, implying that the approach used for analysing patient case reviews in the hospital each week was not perceived by the students as adequate preparation for the assessments.

We would probably even benefit more from that by having a lot of tests, open book tests, they may not have three questions, maybe one question say every month, because I actually feel that the more we practice, then the better we become. (P5:2013:Post ELP)

At least once a week or once every two weeks, to have a case, and to get together for a report back, for those that want to do it, I think it's an opportunity for learning, because ... even though we had those practice cases, it really did help but still, it didn't prepare you. (P3:2013:Post ELP)

Further discussion around the approach for analysing patient case reviews and the approach required for the open book assessments revealed that many students did not apply

an integrated approach to their patient case reviews, citing a need to divide work amongst group members in order to get the work done on time, as explained by the following two participants.

> *I didn't really benefit much from the SOAPs in terms of connecting it to the open book tests, because ... when we did our SOAP, it was a matter of time and also marks, so sometimes we ended up dividing the work so we give problem one to this one, and then problem two to that one. (P5:2013:Post ELP)*

> *Lots of the groups split it up, you do this section, you do that problem, so actually you don't get that integration. (P3:2014:Post ELP)*

Only a few students recognised the similarity in approaches for clinical case analysis and the link between the ELP-based clinical activities and the assessments, as illustrated by these two participants.

> *The best advice that I was ever given was to do the open book test like you would a SOAP, take the steps that you do in a SOAP and apply them to your open book. For example, look at the drugs, analyse the drugs, think of why they are being used and look at possible interventions, and then document it. (P4:2013:Post ELP)*

> *With the open book, what was helpful for me was in terms of decision making, because at the end of the SOAP write-up, you have to make a decision where you have to say which drugs to stop, drugs to continue, and make a decision then, so I think that was very crucial for the open book. (P6:2013:Post ELP)*

Another aspect that was identified as necessary and beneficial for learning was feedback on the case analysis, as explained by this participant, who felt that making clinical cases available for practice purposes was not sufficient, as much of the learning occurred when the lecturer reviewed the cases.

> *The idea of giving the feedback is very important as it shows you where you went wrong ... sometimes I feel that we need more time to spend and check what is*

happening, we need more of those scenarios and stuff, and maybe give us help in that way. (P6:2013:Post ELP)

Open book clinical case study based assessment

The same difficulty in filtering and integrating information was described for the clinical case study analysis in the first open book assessment, as expressed by the following participants. This difficulty was experienced by many students, although a practice assessment paper with three clinical case studies had been distributed to the students and reviewed in class prior to the first written assessment.

You don't know how to approach the written exam, because when you're sitting and doing the open book, you think you're getting everything right, because you've got your resources. (P3:2013:Post ELP)

What I found difficult was knowing exactly what information, to what extent, to include. (P14:2015:Pre-INT)

What I found difficult was, because it was our first open book, I didn't know what to do. (P12:2015:Pre-INT)

I was also anxious, and I had problems identifying the problem in the case because I was very anxious. (P10:2015:Pre-INT)

I think my problem was that I'm so used to the way pharmacology has been asked in papers in the past ... you already know what the teacher is expecting from you, which sections to study, and now [with the open book case study based test], we are given so much liberty to do whatever, you don't know where to start, there's just so much freedom. (P7:2015:Pre-INT)

Although most of the students experienced difficulties in approaching the case study-based assessment, a structured plan of approach to the open book assessment was described by one or two students, who appeared to have made the connection between the

examples of clinical scenarios used in the Pharmacology2 and Pharmacology3 practical sessions to the current style of assessment.

> *After that [practice example], I realised that we had actually been doing case studies for our whole life since second year. So I went back, I took out my second year notes, and I started practising on them in preparation for the text ... and that helped a lot. (P8:2015:Pre-INT)*

> *I had that realisation ... that on Friday when you went through the past papers and when you were presenting, and I thought, isn't this the same thing as the SOAP, but we were finding the problems and creating our own problems and I was like, this is the same approach. (P7:2015:Pre-INT)*

> *It made me realise that the patients that you are screening is a case scenario, really like an open book, it's in a different situation but often it's basically the same thing. (P12:2015:Pre-INT)*

The need for more assistance was expressed on several occasions, as expressed by this student.

> *You just sometimes don't know how things happen, and you need extra support, so if the lecturers could pay attention to the students that are struggling. (P4:2013:Post ELP)*

Several practical suggestions were made which could improve the integration of information by students.

> *Highlight five points here, five red flags, because then they straight away start picking up, okay here's the five most important points of our SOAP, or maybe ... highlight the points in each problem, sometimes you've got quite a few problems, so there's not just five red flags, there's like 10 red flags. (P1:2014:Post-ELP)*

> *With the patient scenario, make them pick out five things that are wrong, I think that would be great. I think for some people it's like you're staring at it, but you're*

like, I don't see anything, you know, what's wrong, what are you talking about, so I think it forces you that okay, there has to be something, think, so I think that would be really good because some people have a hard time. (P3:2014:Post)

When you went through how to write an open book test, you had a Powerpoint slide with a checklist, and I went and wrote those points down ... for example make sure you stop the drug, don't use activated charcoal for an IV dose and I literally checked off each and everything, and it says, make sure that you've gone through each drug. (P2:2015:Pre-INT)

4.3.4.2 Group work

The merits of group work and learning from one's peers was discussed in length, with several students describing a positive learning experience when analysing patient cases together:

We often got together as a group, in the evenings and worked on it [the patient case review] and maybe I picked up something that someone else hasn't, so it is nice to just be able to discuss it and to just sit and look at it yourself, pick up what you see as problems but then also have that discussion, so that if there's something you've missed, you know about it and you know what to look for next time. P2:2014:Post ELP

I also think in as much as the SOAPs helped with the open book, like making the link with the open book, I think it's more the group work when you are doing SOAPs. (P7:2014:Post ELP)

I also got some fourth year papers that the fourth years had kept and I had done those. I also didn't do them alone. Because when you do them on your own you have your own viewpoint. I did it with friends, so that we would do it at home and then come back the next day and we would compare and we always had different opinions on the same thing. (P8:2015:Pre-INT)

However, this viewpoint was not shared by all participants, with some students describing group work as a negative learning experience, often as a result of conflict and a lack of cohesion amongst group members.

> *The group thing can make such a big obstacle in some of the groups because they don't really get to enjoy the programme. (P3:2014:Post ELP)*

> *I didn't really benefit much from the SOAPs in terms of connecting it to the open book, because many times, when we did our SOAP, it was a matter of time and also marks, so sometimes we ended up dividing the work, so we give problem one to this one, and then problem two to that one. (P5:2013:Post ELP)*

> *At times I would find that I did something and I did brilliantly, but then my group members didn't like what I said, so the submission has changed and the group members don't see the final version that is submitted. So it doesn't work, this group work thing. (P16:2015:Pre-INT)*

> *When we first started, we were doing it [the patient case review] together as a group at first, but that one didn't work for us, because you can see that now people were always fighting. It was getting intense. (P5:2015:Pre-INT)*

The value of individual work was also stressed by several students, who felt that self-evaluation was an important learning tool when working on the patient case reviews, as explained by these two participants.

> *In a group we can work altogether and then there's like somebody who looks at it and they can't pick up a problem and there were times when I'm like, we have a severe interaction here and they're like oh really, and I'm like, yah, it's quite bad, can we do something, so it did help to do it yourself first, so you know where you are going and then you discuss it. (P2:2014:Post ELP)*

> *So the individual work would also be like, important because when there's stronger people in the group …you always say, I don't know, I can't do that, I'm not good*

at that, because you know there is people that are good in that. (P4:2014:Post ELP)

One participant recommended that the patient case reviews could be used as practice questions and students could then analyse these cases both as individuals as well as in their groups, implying that benefit was gained both from the individual point of view as well as from the peer discussion of the cases.

So maybe for the practice more, if they took some practice questions like a SOAP form … [do them] as individuals, so that you can develop your way of looking at things. When you are doing it as a group, she finds the link, I find the link, and then you put it all together, but in an open book you have to find the red flags all by yourself. (P7:2014:Post ELP)

4.3.4.3 Active participation

The need to be actively involved in the analysis of patient case reviews was mentioned on several occasions, both in relation to group work when preparing the patient case reviews, as well as listening to case presentations at the weekly report-back sessions.

I learn by doing and seeing and observing whereas some people like to sit and research and look through their stuff, so I think that's why it helped me so much, to see it done. I remember it and I've learnt it and I can now apply what I've learnt. (P2:2014:Post ELP)

If we could only have started analysing the problems earlier [in the case presentation sessions] ... I really found the feedback session on Fridays more valuable when we had to start looking for problems ... before that I was kind of an inert body. (P4:2014:Post ELP)

The case presentations by the different groups at the report-back session were identified as useful, as explained by participant 8 below.

> *Friday feedback sessions, I felt that was really nice, because we got to actually see interesting cases and then we could see the drug list and we had an opportunity as well to look and pick up drug error. (P8:2014:Post ELP)*

4.3.4.4 Summary of the findings from the focus groups (development of design of intervention)

In summary, there were four key concepts that were identified for the design of the intervention, which are listed below:-

a) The need for a **more structured approach** to analysis of the patient case which would focus the student on where and how to start;
b) The need for more **hands-on practice at clinical case analysis**, with opportunity to practice both as individuals and as a group;
c) The need for lecturer-led **feedback** and opportunity for **questions and discussion**;
d) **Active participation** in the clinical case analysis.

These four key concepts were incorporated into the design of the intervention, which was subsequently implemented over a seven week period during Phase Two (2015), while students were participating in the ELP.

4.3.5 Structure and Content of the intervention

Each academic support session of the intervention was structured around the review of one patient case during the hour-long session, and the whole class worked on

the same patient case each week. Each intervention session was conducted using the same approach:-

- At the start of the session, each student was provided with a printed copy of an **actual patient case** (set up in the template used by the students for their patient case reviews). The patient case reviews were sourced from write-ups submitted by final year BPharm4 students in previous years (2013 and 2014), in order to provide authentic, "real-life" clinical cases.
- The session commenced with 10 to 15 minutes of silence during which time each **individual student** was expected to read through and analyse the patient case. Students were permitted to use any resource, printed or electronic, which they had brought to the session.
- This was followed by 15 to 20 minutes of **group discussion**, during which time the group members were able to compare and discuss their analysis of the case with their peers. The students worked in the same groups that they were placed in for the ELP.
- The remaining 20 to 30 minutes of the session was dedicated to **feedback** on the case. This part of the session was facilitated by the researcher, using a systematic structured approach to case analysis each time - this approach had been developed by the students, under the researcher's guidance, during the first session in week one (Table 4.8). Students were encouraged to lead the discussion, to ask questions and to share aspects of their analysis which were different or had not been mentioned. The input from the individual students was open for **discussion** and input from the class (and the researcher, if warranted).

At the first session, students were asked to think about their approach to the case review and the approaches were then discussed during the feedback time in order to formulate the **structured, stepwise approach** to a patient case review, as agreed upon by the students, and guided by the researcher:-

a) Do you know each drug on the medication list? (emphasises the need for drug recognition and factual pharmacological knowledge)
b) Is there a reason for the use of each drug in this patient? (encourages integration of information by linking the medication, including doses, to the medical condition and encourages the recognition of prescribing trends)
c) Awareness of the timeline (chronologically links symptoms and clinical information to medication use)
d) Are there any triggers or red flags, such as pregnancy, renal impairment or medications more likely to cause problems like warfarin, aminoglycosides, phenytoin (encourages recognition of potential medication-related issues)
e) Are there any potential drug interactions? (factual pharmacological knowledge)

Table 4.8
The structure of the intervention (weekly academic support sessions)

Week	Patient Case	Structured Approach
ONE	Daily patient case review (screening) form - case 1	*Identifying medicine-related problems* - Identifying triggers or red flags or alerts
TWO	Patient case review - case 2	*Problem recognition:-* - linking the medication to the clinical information and lab tests - looking for triggers
THREE	Patient case review - case 3	*Problem recognition:-* - linking the medication to the clinical information and lab tests - looking for triggers - awareness of the timeline
FOUR	Patient case review - case 4	*Problem recognition and when to intervene* - linking the medication to the clinical information and lab tests - looking for triggers - Awareness of the timeline
FIVE	Patient case review - case 5	- When should a pharmacist intervene and why, or why not?
SIX	Patient case review - case 6	*Clinical decision making* - linking the medication to the clinical information and lab tests - looking for triggers - constructing the timeline - is the medication-related issue, life threatening and a contraindication?
SEVEN	Patient case review - case 7	- Does the medication need adjustment (eg dose) but could be continued once corrected? - Does the medication require close monitoring ie use with caution - but could be continued if monitored? - Is the medication-related issue for noting as no problems are currently being experienced and the medication can be continued?

The following six sessions were held on a weekly basis, and were used to reinforce the structured, stepwise approach, with exposure to a different patient case review each week, with increasing complexity of the cases (Table 4.8). Initially, the focus was on the medication and identification of medicine-related problems. The next two sessions (weeks two and three) included the clinical information and laboratory investigations, with the aim of integration of information, in addition to promoting awareness of the timeline of events. Weeks four and five focused on pharmacist interventions and clinical significance of medicine-related problems. The last two sessions (weeks six and seven) reinforced the

process of clinical decision making when problem solving, and resolving potential medication-related issues.

4.3.5.1 Summary of the structure and content of the intervention

The structure and content of the intervention therefore addressed the four key concepts that were identified from the emergent themes in the focus groups (section 4.3.4.4). A structured and systematic approach was developed and used for clinical case analysis; actual patient cases were made available as practice examples, with immediate feedback through discussion and question time at the end of the session; active participation in the process was encouraged by the initial "silent" time for case analysis by individual students and lastly, learning from peers was encouraged using group and class discussions on the case analysis. The actual number of students present at the seven weekly sessions was not recorded due to the fact that the students had voluntarily consented to participate in the research, and the academic support sessions were not compulsory. However, attendance of the sessions was observed by the researcher, to be over 95%, based on the number of complete groups working on the case-based problem each week.

4.3.6 Students' Experience of the Intervention - the Focus Group session

The last two sections in this chapter will present the qualitative data obtained in order to describe the students' experience of the intervention. The data was sourced from the Post-Intervention Feedback questionnaire administered in 2015, to the experimental cohort (Phase Two), on completion of the ELP and intervention, and the sixth focus group (2015:Post-INT) which was conducted with a subset of the experimental cohort on completion of the seven week intervention period and the ELP in Phase Two.

A total of six participants responded to the emailed invitation and the focus group was conducted according to the same procedure described in Chapter Three, Section 3.7.2.3. Table 4.9 summarises the demographic information of the six participants.

Table 4.9
Demographic details of focus group participants

	Post-Intervention
	Oct 2015
Number of participants	6
Gender	
Male	2
Female	4
Duration of focus group	48.18 mins

The aim of the post-intervention focus group was to describe the students' experience of the intervention. The guiding questions explored the usefulness of the intervention in terms of its design and the approach used. The discussion was recorded and the audio recordings were first transcribed verbatim before thematic analysis was performed using an inductive approach. Atlas.ti® was used for coding and sub-coding the data. Four dominant themes were identified which are listed in Table 4.10. The results arising from this focus group will be presented under each theme.

Table 4.10
Themes identified during the post-intervention focus group

Learning from peers
Active engagement
Timing of the academic support sessions
Integration of clinical information

4.3.6.1 Learning from peers

One of the key components identified for the intervention was learning from peers. The hour-long academic support sessions included 20 to 30 minutes of group discussion,

during which time the group members were encouraged to share their views on the case, before the lecturer-led feedback and general class discussion took place in the last 30 minutes of the session. The report-back session had always incorporated the concept of peer learning through group-led case presentations, whereas the intervention sessions introduced group discussions during the case analysis.

Group work

The value of the discussion time with group members was recognised by several participants:

> *You get to discuss as a group and then to share some ideas before you present to the lecturer [and the class]. (P1:2015:Post-INT)*

> *You have other people to help you and to see and direct you in how you should think and you can talk to the lecturer, and you can see how other students are approaching the same case that you all have. You get to see how you would approach it and how other students would have approached it. (P4:2015:Post-INT)*

> *[during] the 15 minutes that we actually got with our group, you could then say this is a good choice but how about this drug interaction or this is maybe a better choice than that one and this is the reason why, so it allowed you to go a little bit further into the problem than just having your own opinion. (P3:2015:Post-INT)*

None of the participants in the focus group expressed dissatisfaction with the group discussion component of the academic support session, in contrast to the problems experienced with group work involved in completing the various clinical activities in the ELP.

Case presentations

As mentioned previously, the report-back sessions consisted of case presentations by various groups, providing an opportunity for the students to learn from each other.

When exploring the usefulness of the intervention, most of the participants compared the group-led case presentations in the report-back sessions, to the case analysis process in the intervention sessions. The following three participants found both of these activities to be beneficial:

> *Because we don't all go to the same rotations, and we don't know what other students do at other rotations, so we can get insight into what they are doing there. (P4:2015:Post-INT)*

> *When looking at the presentations, you get a general view of what other students have experienced in the hospitals, so sometimes you haven't yet been to that hospital so when they get a turn to talk, then you get to know some of the drugs that they have come across. (P1:2015:Post-INT)*

> *I think they [case presentations] were also good because you get to have some tips during the question period, from what you [the lecturers] are asking, so at least you get to have those triggers and to see what is happening. (P1:2015:Post-INT)*

However, some students felt the case presentations were a negative experience, and described high levels of anxiety associated with the presentations, which then detracted from the learning experience:

> *If you are doing the presentation, during the presentation you are going to be very nervous but afterwards when other people are presenting, you are just trying to calm down. (P5:2015:Post-INT)*

This participant went on to explain that she felt the importance of the case presentations as a learning activity was minimised because no mark was assigned for the presentation.

> *The presentations, they were helpful of course, but they never really never put me on my toes, because at the back of my mind, I know it's not for marks ... so ... if I*

had other things I had to do, I would do them all before the presentation and then while someone else is presenting, I would quickly look through my presentation. (P5:2015: Post-INT)

This comment was supported by another participant, who felt she was able to use the time far more productively by working on assignments.

It's nice to see what other groups do, but I know our group sat and did that week's SOAP in that session or pulled it together. (P3:2015:Post-INT)

Several barriers to learning from the group-led presentations were identified, such as inaudible presentations, an inability to concentrate, an inability to grasp the details of the case being presented or, not having enough time to process the information and consider their personal approach to the case:

I have a problem because I can't focus the whole time, there's a lot of noise and I don't listen. I won't lie, I don't listen to the whole presentation. (P2:2015:Post-INT)

When you are listening, you can miss some of the things, or not understand. (P5:2015:Post-INT)

Whereas with the case presentations, you are not always sure how you would approach it [analysis of the patient case] (P4:2015:Post-INT)

4.3.6.2 Active engagement

Another key requirement of the intervention was the need for students to actively participate in analysing clinical cases, as many students identified that they needed more practice in order to develop these skills.

I personally preferred the second session [intervention] from the first one [case presentations by peers] because then you are also able to participate and play an

active role, so in that way I learnt and I actually take part and I think. (P5:2015:Post-INT)

Several students appreciated the opportunity to self-evaluate their case analysis skills during the 10 to 15 minutes of individual work.

So definitely doing a little bit by yourself first, helps because you don't have your friend in your open book test. I think that was really important to spend that 10 minutes going through your own thing. (P3:2015:Post-INT)

The 10 minutes that you get to do the case on your own, helped me see where I stand in terms of my pharmacology, compared to what my peers have done. (P2:2015:Post-INT)

Lastly, the coordinated involvement of the whole class working on the same case was seen as beneficial.

When we were allowed to speak as a group and when we discussed with the whole class, everyone was on the same page, because everyone in the group had delivered their own little bit of information, and then as a group, as a whole, you've got the whole picture, and most groups have the same picture. (P3:2015:Post-INT)

4.3.6.3 Integration of clinical information

Five of the six participants emphatically agreed that the structured approach to clinical case analysis helped with their approach to medical files in the hospital as well as the open book case study-based assessments. The remaining participant explained that although the approach helped, he still struggled with the clinical decision making process when resolving medication-related problems and time management in the open book assessments.

> *I think also the approach is good, except I am lacking when it comes to making clinical decisions. That's where the problem is. Time management and the clinical decision making. What to start or change? (P1:2015:Post-INT)*

Clinical environment

The intervention provided a more structured approach to the review of patient cases and aimed at showing students how to link information for an integrated approach when reviewing cases. This approach proved to be useful in the clinical setting, as these two participants explained. There was also a sense of knowing where and how to start the review process.

> *It made it so much easier to interpret the whole information that you get as students from the files … because we already sort of know what's going on with the SOAP, but not really on that level. (P6:2015:Post-INT)*

> *Even in the hospitals, in terms of looking for interventions, if you see that maybe there's warfarin on the screening form, you know where to go. It's not that you only going to focus on warfarin, but you know where to start. (P2:2015:Post-INT)*

Open book case study-based assessments

The integration of information was also a key component required when analysing cases in the open book case study-based assessments, and the benefit of the intervention was confirmed and described by the following two participants.

> *It was especially good for the open book test, because there were like tips on what you have to look at, when you see a drug, to also think to look at the lab tests, how to link the information, so I think that's why I preferred the second session. (P5:2015:Post-INT)*

> *It definitely helped, especially with the open book test, because now you sort of know where to begin, and you know your endpoint as well… now you know the things that you should really focus on. (P6:2015:Post-INT)*

4.3.6.4 Timing of the academic support sessions

Several of the participants commented on the timing of the academic support sessions, commenting that these sessions were of great value and therefore should be introduced earlier, at the start of the ELP.

> *It would be much better if the Friday afternoon sessions [intervention] could be started even before the students go to the hospital, because it made it so much easier to interpret the whole information that you get as students from the files. (P6:2015:Post-INT)*

4.3.6.5 Summary of the post-intervention focus group findings

In summary, the results from the focus group indicated that the intervention was of benefit and provided the required additional academic support, both for the integration of information in the clinical environment as well as in the open book assessments. The participants found the format of the sessions to be worthwhile, citing active involvement in the patient case analysis as a factor which enhanced and facilitated their learning.

4.4 POST-INTERVENTION FEEDBACK QUESTIONNAIRE - STUDENTS' EXPERIENCE OF THE INTERVENTION

On completion of the seven week intervention during Phase Two of the study (2015), all of the students registered for the Pharmacology4 module were invited to complete a Post-Intervention Feedback questionnaire. The questionnaire posed three open ended questions with respect to the intervention:-

> ***Question 1***: How did you find the structure and format of the academic support sessions that were conducted in the afternoon?

Question 2: Did a more structured approach to patient case analysis help you apply and integrate information?

Question 3: Did you find that you learnt from your peers during the discussions in the academic support sessions that were conducted in the afternoon?

Of the 111 participating students registered for Pharmacology4 in 2015, a total of 104 students completed the Post-Intervention feedback questionnaire, giving a response rate of 93.7%. Confidentiality of the respondents was achieved by the replacement of the student number on the questionnaire with a unique study number to ensure anonymity for all respondents. The handwritten open ended questions were first transcribed, before coding for the dominant themes arising from each question, using Atlas.ti®.

The emergent themes and the frequency of occurrences of the themes and sub-themes are summarised in Table 4.11, and Table 4.12.

Table 4.11
Themes identified in Question One of Post-Intervention Feedback questionnaire (frequency and examples)

THEMES	FREQUENCY OF OCCURRENCE % (n)	EXAMPLES OF QUOTATIONS THAT ILLUSTRATE THE THEME
Academic year	**2015**	
Number of respondents	n = 104	
* Number of responses	**n = 197**	
QUESTION ONE: How did you find the structure and format of the academic support sessions that were conducted in the afternoon?		
Actively involved	23.9% (47)	*We all got to look at what was going on by ourselves and at our own pace, in our own way so we could process the information. We could also then see the different approaches taken by our group members and we could decide what works for us best. (P69:2015)*
Difficult to listen to and follow case presentations	17.3% (34)	*During the case presentations I am easily distracted as the majority of students are very nervous when they present. Subsequently I felt that the message and learning potential of the cases that were presented were not optimal and were obscured. (P87:2015)*
Need a structured approach	14.2% (28)	*Gave insight on to how to approach the soap with a logical way. Even though at times things seemed simplified, it did help a lot when looking at the bigger picture .. the afternoon sessions gave me skills to approach cases using a structured analysis, which I think will be applicable in the work environment (P67:2015)*
Learnt from my peers	10.7% (21)	*Interacting with other students and hearing their opinions and methods and way of thinking helped me to make comparisons I would not have had if it had been done as individual tasks (P37:2015)*
Inclusive	9.6% (19)	*The environment was also conducive and encouraging my thoughts as it took an interactive approach from everybody in the class. (P34:2015)*
Feedback during the session	9.1% (18)	*They were extremely useful in getting me comfortable with analysis of patient cases .. which actively involved the group members in dealing with the case and receiving feedback right away. (P12:2015)*
I felt I had learnt something	8.1% (16)	*The afternoon sessions you walked out feeling that you had learned something (P46:2015)*
Timing of the academic support sessions	7.1% (14)	*I do feel that these sessions would have been far more useful if they were done earlier in the year and possibly before hospital rounds even started and definitely before the first open book test as this would have prepared us more than listening to the soap cases being presented (P40:2015)*

**Note:* when more than one theme was identified as a response, all the themes were included. The number of responses is therefore greater than the number of respondents as multiple responses were recieved from one respondent.

In light of the extensive and descriptive feedback provided by the students, the results are summarised in Tables 4.11 and 4.12 but will then be discussed according to the themes identified in the written response to the three open ended questions, supported by relevant quotations to illustrate the students' experience and feelings.

4.4.1 The structure and format of the intervention (academic support sessions)

Question One of the Post-Intervention Feedback questionnaire asked the students to comment on the structure and format of the academic support sessions in the afternoon, compared to the group-led case-based presentations that took place in the morning during the Friday report-back session (Section 1.6.2). An overwhelming majority of students (95%: n = 104) preferred the format and structure of the academic support sessions presentations, which they found to be more useful and very helpful. Only one student did not agree:

> *I didn't feel that this was something that needed to be taught as it was self-explanatory. (P14:2015).*

Two of the students felt that both the format of the case presentations and the academic support sessions were useful and explained that they did not prefer one approach over the other, as both were beneficial. Two students left this question blank.

4.4.1.1 Active participation

The dominant theme identified as the reason for preferring the academic support session was the students' need to being actively involved in the analysis of the cases, rather than merely sitting and listening to groups presenting their cases.

I found the afternoon sessions to be much more useful as I had to actively participate and learn what I was doing wrong in my approach to both the SOAPs and open book tests. (P89:2015)

They were a refreshing change as they encouraged us to be active and not just listen to how other students analyse the case. (P11:2015)

The afternoon sessions were far better, because contrary to listening to case presentations, we could analyse the situations and discuss in groups. Being involved in such a way is always good for learning. (P71:2015)

The afternoon sessions were more useful. It forced us to participate and look things up which encourage learning more than just listening to presentations which sometimes became a bit monotonous. (P32:2015)

We could focus more because we were doing the work and it was easier to take notes and to learn something. More emphasis should be placed on the afternoon sessions. (P90:2015)

These sessions were the best. They were really helpful. They equipped us on how best to approach our SOAPs and open book tests. Having to practice and look at the problem myself in the afternoon was the best and I loved it. (P4:2015)

I found the afternoon sessions to be much more useful as I was able to do it practically and ask questions when I was in doubt. This helped me immensely with regards to what to look for, drugs or lab tests, when I was reviewing a patient's case. This prepared and put me at ease before the second open book exam because I was more informed and I was able to ask questions. My interpretation of a patient case became much easier. (P6:2015)

4.4.1.2 Barriers to learning from student-led case presentations

Although many of the students recognised the educational value of listening to case presentations at the report-back sessions, in reality, there were barriers that negatively impacted on the learning experience. Several factors like noise, the large class, poor

presentation techniques and an inability to concentrate were cited as reasons limiting the effectiveness of these sessions.

> *It was sometimes difficult to follow presentations by other groups. (P93:2015)*

> *The morning sessions were trying sometimes especially when the presentation was too long. (P102:2015)*

> *Sometimes in the presentation, not all the information is provided and you do not understand the case properly. (P64:2015)*

4.4.1.3 Structured approach

Many of the students identified that the stepwise approach to the patient case analysis helped them in both the clinical setting and the open book case study based assessment, as illustrated by these four quotations.

> *The structured layout of analysing the cases helped [me] to identify the most relevant problems and to change the regimens. (P82:2015)*

> *As part of my personality type, I strive to live structured and I handle things in a structured manner. If I'm given steps or instructions to follow I cope much better (P30:2015)*

> *The afternoon sessions help me develop my approach to the case studies and analysing things more effectively. It taught me how to solve problems and gave me a stepwise approach to cases. The afternoon session definitely did much more for my learning than the morning sessions. (P96:2015)*

4.4.1.4 Peer learning

The input of peers was identified as a valuable part of the academic support sessions by many students, who found that they learnt from their group members when reviewing the patient cases.

I learnt so much from the afternoon sessions. I could engage with the group and learnt from fellow students. (P77:2015)

It offered more opportunity for interaction with my whole group, and this highlighted critical areas that I should be aware of. (P95:2015)

4.4.1.5 Inclusive format

The inclusive format of the academic support sessions was identified as beneficial by several students, who explained that they enjoyed the interactive nature of the sessions and felt part of the discussions taking place. Students also appreciated the smaller sessions, which accommodated between 50 to 70 students per session. The researcher noted far more interaction from the students during the lecturer-led case review and discussion period during the last 30 minutes of the session. This interaction was characterised by lots of questions and responses, often between students, as well as student to lecturer, with the lecturer facilitating the discussion. The active engagement and participation by the students in the review session led to this part of the session often running over time.

Since the group was smaller, interaction with the lecturer was possible. (P102:2015)

The sessions were very useful because we got to interact as a class. (P68:2015)

I found it very useful because I was able to discuss with my peers as well as with the lecturer what I thought and I was able to freely ask any questions. (P43-2015)

The afternoon sessions were very useful and were more useful than the case presentations. There was more time to understand the case in question and there is more interaction with the lecturer. I learnt more and I learnt a lot during the afternoon sessions. (P39:2015)

The afternoon sessions were inclusive and allowed one to be part of a group to actively evaluate an actual case, thereby making it so informative and giving me a

platform to learn. I learnt so much from the afternoon sessions. I conducted research and I could engage with the group and are also learned from fellow students in my group. (P77:2015)

4.4.1.6 Feedback during the session

A couple of students highlighted the benefit of obtaining immediate feedback on the case at the end of the session, explaining that the case review and resultant discussion between students and the lecturer really enhanced their learning.

It was also very useful because we got the feedback from the SOAP cases there and then, which helped me to check where I went wrong and that helped me not to repeat the same mistake again. (P58:2015)

The sessions were really helpful especially when they were combined as a feedback and the SOAP analysis session (P28:2015)

4.4.1.7 Educational value

The educational value of the academic support sessions was clearly recognised by the students, as illustrated by the following two quotations.

The afternoon sessions you walked out feeling that you had learned something. (P46:2015)

I saw myself really growing after the sessions. (P65:2015)

4.4.1.8 Timing of the introduction of the academic support sessions

The academic support sessions were introduced after the students had completed two rotations in the clinical setting and, the first formative case study-based open book assessment had been written. The timing of the introduction of these sessions was heavily criticised by many of the students, who felt these sessions were required as they started the

ELP and before the first assessment. The following comments illustrate these concerns and criticisms.

> *I just wish the sessions was started earlier as it would have facilitated and complemented the hospital programme and the approach to the SOAP cases and the open book exams in a more than additive way. (P17:2015)*

> *It was way beyond useful, and I feel it should have been started in the first semester as we started the hospital programme before our first open book test. (P78:2015)*

> *The afternoon session should have been done earlier because I believe it would have helped with the preparation for the open book tests. It helped me feel more at ease during the open book test. (P84:2015)*

> *The session revealed vital information that should have been adequately covered in the first semester at the start of the SOAPs prior to the open books. I failed the open book test as I failed to understand these trigger points. I did not know what to study and the approach to take (P76:2015)*

4.4.2 Integration of information using a structured approach to case analysis

Question Two (Table 4.12) asked the students if the academic support sessions enhanced their ability to apply knowledge and integrate information, considering both the clinical environment and the open book clinical case study-based assessments. Again, the overwhelming majority of students (89.4%; n = 104) felt their ability to integrate information had improved, although students differed in their opinions as to whether the improvement was noticeable in the clinical environment as well as the case study based assessments. Three students left this question blank.

There were eight negative responses (7.7%; n = 104) to this question. The timing of the academic support sessions was identified as problematic, with students complaining that it should have been introduced earlier in the year.

No, when the structured approach was given to us to use, it was already a little too late. It should've been done earlier in the year. (P3:2015)

No, not really because it didn't find it difficult in the first place. (P14:2015)

Two of the students did not feel that the academic support sessions were necessary.

I did not see the need for it ... I didn't find it difficult to see the whole picture and identify problems. (P9:2015).

4.4.2.1 Prepared for patient case analysis

The majority of the students described how the structured approach improved their ability to apply knowledge and integrate information for case analysis and problem identification in the clinical setting, and felt their confidence had improved when interpreting clinical information:

It definitely did help because during term one and two it was very difficult to find triggers but after the session is was as easy as ABC. (P57:2015)

Definitely. The sessions helped me to identify triggers, like life-threatening situations, and where to make the necessary changes. I am a lot more confident in intervening about pharmacology because I have learnt the importance of evaluating medication and how to find and have a solution to triggers. (P77:2015)

The way in which we actually approached the SOAP and the cases was the same way in which we approach the open book. It was much easier to know what to look for and where to find it. (P10:2015)

Table 4.12
Themes identified in Question Two and Three of Post-Intervention Feedback questionnaire (frequency of occurrence and examples)

THEMES	FREQUENCY OF OCCURRENCE % (n)	EXAMPLES OF QUOTATIONS THAT ILLUSTRATE THE THEME
Academic year	**2015**	
Number of respondents	n = 104	
* Number of responses (Question 2)	**n = 89**	
* Number of responses (Question 3)	**n = 137**	
QUESTION TWO: Did a more structured approach to case analysis help you integrate information?		
Feel better equipped for case analysis	91.0% (81)	*I was able to pick up trigger drugs in the hospital and also the red flags. I managed to screen more patients and I found more pharmacist interventions. As the hospital programme went on I found it easier to screen cases and look out for things that were incorrect. (P2:2015)*
Decision making	6.7% (6)	*The case reviews helped me find a way, a stepwise process to the problem and giving the solution (P42:2015)*
Able to link information	2.3% (2)	*They helped me .. identify the relevant lab tests linking to the drug management. (P31:2015)*
QUESTION THREE: Did you find that you learnt from your peers during the discussions in the afternoon sessions?		
Learnt from my group members	62.0% (85)	*Everyone picked up something different from each case which made me more aware of what to look at and why in certain circumstances. This helped me to change and adapt my way of thinking (P6:2015)*
Expanded my way of thinking	31.4% (43)	*Yes. Different ideas and ways of approaching have helped me a lot. I have copied a lot of answering strategies from my colleagues and hopefully this will help me pass my open book tests. (P27:2015)*
Familiarity	6.6% (9)	*Through the discussions I learnt from my peers and everyone had no opportunity to voice their opinions and it's easy to ask about something you do not understand from one of your peers (P33:2015)*

**Note:* when more than one theme was identified as a response, all the themes were included. The number of responses is therefore greater than the number of respondents as multiple responses were recieved from per respondent.

The structured review approach to the case reviews helped me. At first I did not know what to look at or where to start in terms of analysing hospital cases as well as the open book cases. (P33:2015)

4.4.2.2 Integration of information

Two of the students specifically identified their improved skills in linking information when reviewing patient medical files.

The afternoon sessions helped me understand how to critically analyse the case. Before these sessions I had never really looked at lab tests of the patient and what they could indicate. (P21:2015)

They helped me identify trigger drugs and identify the relevant lab tests linking to the drug management. (P31:2015)

4.4.2.3 Decision making

An area identified as difficult by many students when resolving medication-related problems, was the decision making process. The following participant specifically identified that the structured approach helped with the decision making process:

The structured approach helped me with all aspects of my pharmacology, especially in deciding on an appropriate action, for example monitor closely but continue therapy versus stopping the drug immediately. This was often a problem before because I could identify the problems or triggers but I didn't know what to do about them. (P96:2015)

4.4.3 Learning from peers

Question Three explored the educational value of peer learning, in light of the group discussions during the academic support sessions. Most of the students (82.7%: *n*

= 104) felt the discussions with their group and their class enhanced their learning, although some indicated that their group members did not really add to their knowledge, and that they preferred to work as individuals. Two students left this question blank. Three sub-themes were identified, namely: learning from group members; expanded way of thinking and familiarity (Table 4.12).

4.4.3.1 Learning from my group members

Overall, the majority of students identified the group discussions to be worthwhile and beneficial when learning how to approach the case reviews. Many students identified the knowledge gained from hearing their peers describe different techniques, which could then be adopted and applied to their approach.

> *Discussions with my peers were very helpful because it gave different solutions or opinions on how to deal with a particular case scenario. It felt like the discussions we have when writing up a SOAP. (P43:2015)*

> *Everyone picked up something different from each case which made me more aware of what to look at and why in certain circumstances. It also helped us identify what each member is stronger at. This helped me to change and adapt my way of thinking (P6:2015)*

> *With pharmacology it's better to actually discuss things. It's easy to remember them in that way and it helps to stimulate and to open up your mind and you get to also pick up things that you did not see at first that you would have missed if you had done it on your own (P10:2015)*

During these sessions, the researcher observed that the majority, and in most cases, all the group members actively participated in the scheduled discussion time, with worthwhile and often noisy engagement between group members as they focused on and debated the problem at hand. The researcher also noted on several occasions that the group

members would get to a point of indecision where they required input. After discussions with the group, this point was then followed up by the lecturer during the case review and discussed with the class as a whole. Unfortunately, the group discussions were not always a positive learning experience, as expressed by these participants who identified conflict in the group, feelings of inadequacy, exclusion and a preference for individual work:

> *It got me feeling even more incompetent. (P12:2015)*
>
> *Yes, we learnt a lot from each other but this group fought all the time which was not nice and as a result people started debating. (P57:2015)*
>
> *No, lots of disagreements. (P59:2015)*
>
> *Not really. I focused more on my own technique and what the lecturer was saying. (P7:2015)*
>
> *No, not really, as I would prefer to stick to my own technique and what I felt comfortable with. (P103:2015)*
>
> *Working in groups for the sessions is not ideal, because you want to train your own thinking process on your own, because that is the case in the tests, without someone else saying something that leads the whole group to look at the case in that view. If we worked alone, we can then do self-assessment and thereafter see where we need to improve. (P79:2015)*

4.4.3.2 Expanded my way of thinking

The group interaction definitely assisted some students in thinking differently and more critically about the cases, and was identified as a major advantage of the group work component of the sessions:

> *It also aided me in broadening my way of thinking because interacting with other students and hearing their opinions and methods and way of thinking helped me to*

make comparisons I would not have had if it had been done as individual tasks. (P37:2015)

Yes, because they would ask questions I had not thought of and that opened my mind on the types of relevant questions to ask myself when approaching a case scenario. (P88:2015)

4.4.3.3 Familiarity

The comfortable and familiar setting of group work, and working with friends, was highlighted by the following two students who described this as a positive environment in which to learn:

An explanation from a peer that I am comfortable with, is the best way for me to learn. Group discussions also developed my thinking about pharmacology and seeing the bigger picture. (P94:2015)

The group discussions are essential and since I had been with the people for a while, I could easily voice my views on the discussions without feeling like my opinion does not count and I had a greater confidence in talking with people that I know. Different people have different views on the cases and all these views merged together and provided a good analysis. (P76:2015)

4.4.4 Summary of the key findings from the Post-Intervention Feedback questionnaire

In summary, the results presented in section 4.4 demonstrate that the students' experience of the intervention was positive. This finding supported the results obtained from the post-intervention focus group presented in section 4.3, as concluded by this student's viewpoint:

These sessions were really useful. They called for me to participate and play an active role in analysing the SOAPs. They were useful in that they helped me learn

how to collect the most relevant data for a SOAP case. They improved my general analysis of the drug list and relevant lab tests. They helped in an open book to spot the drugs which are most likely to have drug interactions. It was also good to see how the group members approach the questions. (P106:2015)

4.5 SUMMARY OF CHAPTER FOUR

Chapter Four presented the qualitative data obtained from the Pharmacology4 Module Feedback questionnaire, as well as focus groups conducted pre- and post-ELP. Lastly, qualitative data was collected with respect to the intervention, using focus groups conducted pre- and post-intervention and the Post-Intervention Feedback questionnaire.

The data presented has described: details of the students' lived experiences of the ELP and the intervention itself; positive and negative aspects of the ELP; and led to the design of the structure and content of the intervention, in the form of the supplementary academic support sessions; the subsequent evaluation of the intervention from the students' perspective. Chapter Five will present the quantitative data collected pre- and post-ELP, in Phase One and Phase Two of the study.

CHAPTER FIVE: RESULTS (QUANTITATIVE)

5.1 INTRODUCTION

Data obtained using quantitative methodologies will be presented in Chapter Five, while Chapter Six will provide the interpretation and triangulation of quantitative and qualitative data, as well as the discussion of the implications of the findings. The demographic characteristics of the study population will first be described, followed by information on use of English language in various settings; the level of English reading comprehension; academic achievement prior to entering university; academic achievement in the BPharm degree programme and the rate of academic progression through the BPharm programmes; academic achievement in Pharmacology modules; problem solving ability as measured by Raven's Standard Progressive Matrices; individual learning styles; work experience gained in a pharmacy environment and; the retrospective review of written summative pharmacology assessments in Pharmacology2 and Pharmacology3.

Descriptive statistics were used for the analysis of quantitative data in order to summarise and describe the basic features of the data, while inferential statistics was employed to determine the magnitude of any differences found between and within groups. All quantitative data analysis was computed using Statistica®, in collaboration with the NMMU Unit for Statistical Consultation. Descriptive statistical analysis was conducted using measures of central tendency (mean) and variability (standard deviation, and when relevant, range, minimum and maximum). The results were denoted as mean ± standard deviation, with data represented graphically and in tabulated form.

Inferential statistics were computed to determine the statistical probability of differences between and within groups, with a *p*-value of .05 or less indicating statistical

significance. The current research involved an educational intervention, necessitating the practical significance of any statistically significant result to be considered on the premise that successful educational interventions usually have a medium or large effect size (Peeters, 2016; Sullivan, 2014). A Cohen's *d* value of less than 0.5 was deemed to be practically insignificant.

Chi-square test was used in comparisons of the distribution of categorical data between the two independent groups, namely the comparator (ZCL4Comp) and experimental (ZCL4Exp) cohorts. If statistical significance was determined, post hoc analysis with Cramer's *V* was conducted to determine effect size, with a value < 0.3 deemed to be practically insignificant.

Comparisons of the means (such as pre- and post- test scores) between the ZCL4Comp and ZCL4Exp cohorts were conducted using an independent samples *t*-test, which will be denoted simply as *Student's t*-test. Comparisons of the means within the same cohort, utilising a dependent samples *t*-test, will be denoted as *paired t*-test. When statistical significance was detected with *t*-tests, Cohen's *d* was computed to determine effect size, and practical significance. Analysis of variance (ANOVA) was employed when comparing the means of three or more independent groups, and in the presence of a statistically significant result, post hoc analysis was performed using the Tukey's HSD (Honestly Significant Difference) test to compare pairs of means.

Correlation analysis, using the Pearson Product Moment correlation coefficient (*r*), was performed to investigate the strength of the relationship between two variables, with a value < 0.3 suggestive of a weak association, and > 0.5, a strong association.

5.2 DEMOGRAPHIC CHARACTERISTICS OF THE STUDY SAMPLE

NMMU was the research site and the study population consisted of students registered for the BPharm degree offered by NMMU. The study sample consisted of undergraduate fourth (final) year BPharm students registered for the Pharmacology4 module (Module code: ZCL401) for the first time, who had provided written informed consent to participate in the research.

Qualitative data (presented in Chapter Four) was collected during the initial exploratory Preliminary Phase in 2013 from the cohort of final year BPharm students (n = 72). This data was utilised in the design of the intervention, and assisted in the development of key questions for the focus groups conducted during Phases One and Two of the research. Phase One took place in 2014, when baseline pre-and post-ELP data was collected from the ZCL4Comp cohort (n = 70). Phase Two occurred in 2015 with the ZCL4Exp cohort (n = 106) and included the collection of pre- and post-ELP data, as well as the development of the intervention, and subsequent implementation during the ELP in the form of supplementary academic support sessions.

A total of 70 students from the ZCL4Comp cohort (N = 73) provided written consent to participate in Phase One of the research, while 106 students from the ZCL4Exp cohort of students (N = 111) consented to participate in Phase Two, which included the intervention. The number of students in each sample group varied within the data sub-sets due to students being absent on the day of data collection or due to submission of incomplete data. Participation in the pre- and post-testing sessions was voluntary. Sample numbers are therefore reported with each data sub-set in this chapter. The demographic data representing the two cohorts will now be presented.

5.2.1 Gender

The majority of final year BPharm students registered for Pharmacology4 (ZCL401), who consented to participate in the research, were female (72.83%; n = 173). Gender distribution between the ZCL4Comp (Phase One, 2014) and ZCL4Exp (Phase Two, 2015) groups was found to be similar (p = .662: Chi^2, df = 1, n = 173), with females comprising the majority of students in both cohorts, namely 71.01% (n = 69) in ZCL4Comp and 74.04% (n =104) in ZCL4Exp (Table 5.1). This finding reflects not only the global trends seen in gender distribution in the pharmacy profession where women outnumber men, but also supports the finding that females comprise approximately two thirds of all pharmacy graduates (Hawthorne & Anderson, 2009).

Pharmacy is well recognised as a profession which has successfully integrated women into what was previously a male-dominated career (Janzen, Fitzpatrick, Jensen, & Suveges, 2013). Concerns have been raised regarding the lack of male students entering the profession, although reasons for this have not been formally identified. One of the possible reasons suggested is that the advent of corporate chain pharmacies has not been attractive to males who in the past, may have selected pharmacy due to the entrepreneurial possibilities associated with ownership (Janzen et al., 2013). In South Africa, the 2014 Annual Report of the South African Pharmacy Council listed a total number of 13391 pharmacists on the register (SAPC, 2014). By June 2016, the total number of registered pharmacists in South Africa had increased to 13886 with the majority being females (61.00%), while 67.50% of the country's BPharm students on the SAPC register (i.e. BPharm2, BPharm3 and BPharm4 students) were females (n = 3883) (M. Mokoena, SAPC, personal communication, 29th June 2016). Thus the gender distribution of pharmacists in South Africa is in line with international findings (Hawthorne & Anderson, 2009).

Table 5.1

Frequency distribution of gender, age, BPharm programme type, citizenship in the two study samples (comparator and experimental cohorts) of BPharm students registered for Pharmacology4

	Cohorts					
	ZCL4Comp Phase One (2014)		ZCL4Exp Phase Two (2015)		Combined (2014 & 2015)	
	n	%	*n*	%	*n*	%
Gender	*(n = 69)*		*(n = 104)*		*(n = 173)*	
Male	20	28.99	27	25.96	47	27.17
Female	49	71.01	77	74.04	126	72.83
Age (years)	*(n = 69)*		*(n = 103)*		*(n = 172)*	
21-22	24	34.78	43	41.75	67	38.95
23-24	25	36.23	38	36.89	63	36.63
25-50	20	28.99	22	21.36	42	24.42
Mean Age ±SD	25.33 ±5.61		23.66 ±3.14		24.33 ±4.37	
BPharm programme	*(n = 69)*		*(n = 104)*		*(n = 173)*	
4 years	62	89.86	87	83.65	149	86.13
Extended (5 yrs)	7	10.14	17	16.35	24	13.87
Citizenship	*(n = 69)*		*(n = 103)*		*(n = 172)*	
South Africa	46	66.67	87	84.47	133	77.33
SADC	20	28.99	10	9.71	30	17.44
East Africa	2	2.90	3	2.91	5	2.91
West Africa	0	0.00	2	1.94	2	1.16
Middle East	0	0.00	1	0.97	1	0.58
Asia	1	1.45	0	0.00	1	0.58

Gender: Chi^2 (*df* = 1, *n* = 173) = 0.19; *p* = .662;
Age: Chi^2 (*df* = 1, *n* = 173) = 1.50; *p* = .472; *ZCL4Comp vs ZCL4Exp: mean age:* Student's *t*-test, *t*-value = 2.51, *p* = .013, Cohen's *d*: 0.39
BPharm programme: Chi^2 (*df* = 1, *n* = 173) = 1.34; *p* = .248;
Citizenship: Chi^2 (*df* = 1, *n* = 172) = 7.47; *p* = .006, Cramer's *V*: 0.21.
Note: Extended = students registered for the Extended BPharm programme (5 years)
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort.
SADC = Southern African Development Community (Botswana, Mauritius, Namibia, Zimbabwe)
East Africa = Kenya, Somalia, Tanzania, Uganda; West Africa = Cameroon, Ghana
Middle East = Iran, Asia = China

5.2.2 Age

The mean age of participating final year BPharm students registered for Pharmacology4 (*n* = 172) was 24.33±4.37 years, ranging from 21 years to 48 years of age. The mean ages for the ZCL4Comp (*n* = 69) and ZCL4Exp (*n* = 103) groups were 25.33±5.61 years, and 23.66±3.14 years respectively (Table 5.1). A statistically significant

difference in the mean age was noted between the two groups (n = 172), with small practical significance (p = .013, Student's t-test, t-value = 2.51, Cohen's d = 0.39). A possible contributor to the difference noted in the mean age between the cohorts was the number of students above 30 years of age, with a total of ten students in the ZCL4Comp group (14.5%), and three students (2.91%) in the ZCL4Exp group. This may be due to a greater number of students in the ZCL4Comp group having repeated modules earlier in the BPharm programme or the presence of mature students who had previously registered for alternative programmes prior to enrolment in the BPharm programme.

Three quarters of the students (75.58%) in the two cohorts (n = 172) were between 21 and 24 years of age (Table 5.1), with 71.10% of the ZCL4Comp (n = 69) falling into this age group, compared to 78.64% of the ZCL4Exp (n = 103) (Table 5.1). This finding was expected as in South Africa, prospective university students would normally enter the relevant degree programme at the age of 19 or 20 years. There was no significant difference (p = .472) in the distribution of age between the two cohorts **(**Chi^2, df = 1, n =173) (Table 5.1).

5.2.3 Academic Programme

The BPharm programme at NMMU is offered over four or five years. The five year extended curriculum programme provides additional academic support and skills development to students who did not meet the minimum admission requirements for the four year BPharm degree programme (NMMU, 2015). The five year Extended BPharm programme is structured so that the first year modules are presented over two years in order to include additional academic support modules such as English and Mathematics.

The majority of students in the two cohorts were registered for the four year BPharm programme (86.13%; n = 173), consisting of 89.86% of students from the

ZCL4Comp cohort (n = 69) and 83.65% of students from the ZCL4Exp cohort (n = 104) (Table 5.1). No significant difference (p = .248) was found between the two cohorts in terms of the distribution of students registered for the four year BPharm programme and five year Extended BPharm programme (Chi^2, df = 1, n = 173*).* The ZCL4Exp cohort had the greater percentage of students (16.35%; n = 104) registered for the five year Extended BPharm programme.

5.2.4 Citizenship

More than three quarters of the participating final year pharmacy students were South African citizens (77.33%; n = 172), with a further 17.44% of students holding citizenship in a Southern African Development Community (SADC) country (Table 5.1). A significant difference (p = .006) was noted in the citizenship of the students between the two cohorts (Chi^2, df = 1, n = 172*),* which was of small practical significance (Cramer's V: 0.21). Only 66.67% of the ZCL4Comp cohort (n = 69) were South African citizens, in contrast to 84.47% of the ZCL4Exp cohort (n = 103). This may reflect a change in admission policy at NMMU, whereby from 2012, admission placements in the BPharm programme were capped to a maximum of 10% placements for non-South African citizens (S-A Boschmans, Head of Department of Pharmacy, NMMU, personal communication, 22nd June 2016). This decision was taken in response to the national shortage of pharmacists in South Africa and the need to increase the number of pharmacy graduates entering the profession in order to meet this country's health needs.

5.2.5 Language use

South Africa has eleven official languages, although English remains the most commonly spoken language in commerce and official public settings. This linguistic diversity reflects the multicultural nature of South Africa's population of 51.8 million

(Statistics South Africa, 2011). The 2011 census identified isiZulu as the mother tongue of 22.7% of South Africans, followed by isiXhosa (16%), Afrikaans (13.5%), English (9.6%), Sepedi (9.1%), Setswana (8%) and Sesotho (7.6%), while each of the remaining four official languages (Ndebele, Swazi, Tsonga, Venda) is spoken at home by less than 5% of the population (Statistics South Africa, 2011).

Language diversity is even more evident at the university level, where international students (both from neighbouring African countries and further afield) introduce their cultural backgrounds and home languages into the learning environment. At NMMU, English is the language used in formal lectures and assessments in the BPharm programme and is also the medium for learning, both online and in recommended textbooks and published scientific literature. This is in line with global trends. Education in the pharmaceutical sciences has a strong base in science, and English is internationally recognised as the language of science (Drubin & Kellogg, 2012).

Table 5.2 presents the frequency distribution of the use of English by the sample of students, as it is important to understand the student population's language use when investigating factors that can influence academic achievement.

5.2.5.1 Mother tongue

When looking at the combined cohorts (Table 5.2), just over a third of students (37.79%; n = 172) identified English as their mother tongue language (i.e. English First Language or EFL). Half (50.72%) of the ZCL4Comp cohort (n = 69) indicated that English was their mother tongue language, compared to less than a third (29.13%) of the ZCL4Exp cohort (n = 103). A significant difference (p = .004) was seen in the mother tongue language identified between the two cohorts (Chi^2, df = 1, n = 172), which was of small practical significance (Cramer's V = 0.22).

Closer examination of the group of ESL students in the combined cohorts revealed that the most common mother tongue language was isiXhosa (35.84%; *n* = 172) followed by Afrikaans (28.46%; *n* = 172). The finding is in agreement with data from the 2011 National Census (Statistics South Africa, 2011) which indicated that the predominant language spoken in the Eastern Cape was isiXhosa (78.8%), followed by Afrikaans (10.6%) and English (5.6%).

The linguistic diversity of the student population at NMMU was clearly illustrated by the study sample, with a total of 23 different languages named by the students as the mother tongue language (i.e. Afrikaans, English, Farsi, French, isiXhosa, Kalanga, Luganda, Lusoga, Mandarin, Mauritian Creole, Ndebele, Oshiwambo, Portuguese, Sepedi, Setswana, Shona, Somali, Sotho, Swahili, Tshivenda, Twi, Yemba and Zulu) (Table 5.2).

5.2.5.2 Language use at NMMU (tertiary level of education)

Of interest was the change in language usage by NMMU students in the learning environment in the university context, where English was identified by 61.27% (*n* = 173) of the students as the language used in group work sessions, and this usage increased to 79.19% *(n* = 173) for individual study purposes (Table 5.2).

Table 5.2

Frequency distribution of the use of English as mother tongue; language used at home; language of instruction at primary and secondary level of education; and language used at NMMU.

Use of English in different settings			Cohorts					
			ZCL4Comp		ZCL4Exp		Combined	
			n	%	n	%	n	%
			(n=69)		(n=103)		(n=172)	
Mother Tongue		English (EFL)	35	50.72	30	29.13	65	37.79
		Not English (ESL)	34	49.28	73	70.87	107	62.21
Language used at home with family		English 100% time	15	21.74	19	18.27	34	19.65
		≥50% but <100%	9	13.04	11	10.58	20	11.56
		<50% of time	16	23.19	20	19.23	36	20.81
		EFL	29	42.03	54	51.92	83	47.98
Language use at primary level of education (junior school)	*Instruction*	English 100% time	37	53.62	51	49.04	88	50.87
		≥50% but <100%	14	20.29	13	12.50	27	15.61
		<50% of time	5	7.25	8	7.69	13	7.51
		EFL	14	20.29	32	30.77	46	26.59
	Assessment	English 100% time	41	59.42	56	53.85	97	56.07
		≥50% but <100%	10	14.49	17	16.35	27	15.61
		<50% of time	3	4.35	7	6.73	10	5.78
		EFL	15	21.74	24	23.08	39	22.54
Language use at the secondary level of education (high school)	*Instruction*	English 100% time	40	57.97	56	53.85	96	55.49
		≥50% but <100%	15	21.74	22	21.15	37	21.39
		<50% of time	2	2.90	6	5.77	8	4.62
		EFL	12	17.39	20	19.23	32	18.50
	Assessment	English 100% time	46	66.67	58	55.77	104	60.12
		≥50% but <100%	11	15.94	23	22.12	34	19.65
		<50% of time	0	0.00	6	5.77	6	3.47
		EFL	12	17.39	17	16.35	29	16.76
Language used at the tertiary level of education (NMMU)	*Social*	English 100% time	24	34.78	34	32.69	58	33.53
		≥50% but <100%	30	43.48	34	32.69	64	36.99
		<50% of time	10	14.49	26	25.00	36	20.81
		EFL	5	7.25	10	9.62	15	8.67
	Group work	English 100% time	47	68.12	59	56.73	106	61.27
		≥50% but <100%	20	28.99	34	32.69	54	31.21
		<50% of time	1	1.45	9	8.65	10	5.78
		EFL	1	1.45	2	1.92	3	1.73
	Individual study	English 100% time	55	79.71	82	78.85	137	79.19
		≥50% but <100%	14	20.29	20	19.23	34	19.65
		<50% of time	0	0.00	1	0.96	1	0.58
		EFL	0	0.00	1	0.96	1	0.58

Not English or EFL refers to other languages spoken i.e. Afrikaans, Farsi, French, isiXhosa, Kalanga, Luganda, Lusoga, Mandarin, Mauritian Creole, Ndebele, Oshiwambo, Portuguese, Sepedi, Setswana, Shona, Somali, Sotho, Swahili, Tshivenda, Twi, Yemba and Zulu

ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort;
EFL: English First Language; ESL: English Second Language

Mother Tongue: ZCL4Comp vs ZCL4Exp: Chi2: $df = 1$, $n = 172$) = 8; $p = .004$, Cramer's $V = 0.22$

The findings suggest that ESL students may translate their study notes in order to learn in their home language, which could impact negatively on academic progression and comprehension of discipline-specific knowledge (Bharuthram, 2012; Nel et al., 2004). This was in contrast to a lower use of English in the social setting on campus (33.53%; *n* = 173), where the most frequently identified languages used when socialising with friends on campus were Afrikaans, isiXhosa, Setswana, Swahili or Shona (Table 5.2).

5.2.5.3 Language use at primary and secondary level of education

Just over half of the participants identified English as the medium for instruction (50.87%) and the language for assessment (55.49%) at the primary level of education (junior school) (*n* = 173) (Table 5.2). This usage increased slightly at the secondary level of education (high school) to 55.49% for instruction and 60.12% for assessment (*n* = 173).

This finding implies that just less than half of the students in the study sample were schooled in a language other than English, which could influence academic achievement in the BPharm programme, where English is the language of teaching and assessment (NMMU, 2016).

5.2.5.4 Summary

In summary, the study sample was found to be predominantly female (72.83%; *n* = 173), with a similar gender distribution in both the ZCL4Comp and ZCL4Exp cohorts. The mean age of the participants in the combined cohorts was 24.33±4.37 years, with no significant differences noted in age distribution between the two cohorts. As expected, the majority of students were found to be between 21 and 24 years of age (75.58%, *n* = 172). Most of the students were registered for the four year BPharm programme (86.13%, *n* = 173), with no differences noted in the distribution of students between the four year and

five year Extended BPharm programme, when the ZCL4Comp and ZCL4Exp cohorts were compared.

A statistically significant difference (p = .006), which was of small practical significance, was noted in the citizenship of the students, with 66.67% of ZCL4Comp identified as South African citizens, compared to 84.47% of the ZCL4Exp cohort (Chi^2: df = 1, n = 172, Cramer's V = 0.21). There was a higher incidence of ESL students in the ZCL4Exp cohort (70.87%, n = 73), compared to 49.28% in the ZCL4Comp cohort (n = 34), and this was found to be statistically significant (p = .004) (Chi^2: df = 1, n = 172, Cramer's V = 0.22), although of small practical significance.

The results of the survey (Table 5.2) on mother tongue and language use in various settings thus justified the inclusion of the English Reading Comprehension assessment test in the current research, on the basis that only 37.39% of students in the combined cohorts were EFL students (n = 172). The majority of students in the study sample (62.21%, n = 172) were learning in a foreign language (i.e. English). The potential influence of language on academic achievement in the ELP would therefore need to be investigated.

5.3 ENGLISH READING COMPREHENSION

In Phase One (2014) and Phase Two (2015), participating students completed the computer-based English Reading Comprehension test (Chapter Three, section 3.7.1.2). The computer-based tests were written pre- and post-ELP by students in both cohorts (ZCL4Comp and ZCL4Exp). An overall numerical score out of 100 was assigned for the test, and the level of English reading comprehension ability was then interpreted by using the total score obtained (/100) in order to determine the category of level of English reading comprehension ability as follows: *developing* (score between 0 and 42); *expanding* (score lies between 43 to 65); *functional* (score between 66 and 85) and *proficient* (score between

86 and 100) (Table 3.2). Test scores (/100) were then compared between the cohorts and within each cohort, prior to and on completion of the ELP.

5.3.1 Pre-ELP and post-ELP English Reading Comprehension Scores

Prior to commencement of the ELP, the majority of students in the two cohorts (74.56%: n = 169) achieved test scores between 60 and 89 (Table 5.3). Pre-ELP, 73.13% of the ZCL4Comp group (n = 67) obtained scores between 60 and 89, compared to 75.49% of the ZCL4Exp group (n = 102). The distribution of pre-ELP scores obtained by both cohorts (ZCL4Comp and ZCL4Exp) was found to be similar (p = .940: Chi^2, df = 7, n = 169).

Post-ELP, 76.12% of the ZCL4Comp group (n = 67) and 60.79% of the ZCL4Exp group (n = 102) achieved scores between 60 and 89, with no significant difference observed in the distribution of post-ELP test scores between the two cohorts (p = .468: Chi^2, df = 7, n = 169).

One participant in ZCL4Exp group scored below 30 in the pre-ELP test, as well as a different participant from the same cohort, in the post-ELP test. The reason for the very low scores is not known, but it is highly unlikely that the scores were a valid reflection of the students' ability, as both students had been admitted into the BPharm programme and progressed to the fourth year. One possible explanation could be test apathy on the day of the tests, as these tests were voluntary and were not included in the academic assessments for the modules.

Table 5.3
Frequency distribution of pre- and post-ELP English reading comprehension scores (/100) in the Comparator and Experimental Cohorts.

English Reading Comprehension Score (/100)	Cohorts							
	Pre-ELP				Post-ELP			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	n	%	n	%	n	%	n	%
10 to 19	0	0	1	0.98	0	0.00	0	0
20 to 29	0	0	0	0.00	0	0.00	1	0.98
30 to 39	0	0	1	0.98	1	1.49	5	4.90
40 to 49	3	4.48	5	4.90	0	0.00	2	1.96
50 to 59	5	7.46	7	6.86	8	11.94	13	12.75
60 to 69	15	22.39	27	26.47	17	25.37	19	18.63
70 to 79	21	31.34	29	28.43	19	28.36	23	22.55
80 to 89	13	19.40	21	20.59	15	22.39	20	19.61
90 to 100	10	14.93	11	10.78	7	10.45	19	18.63
Total	*67*	100.00	*102*	100.00	*67*	100.00	*102*	100.00

Pre-ELP test scores: ZCL4Comp vs ZCL4Exp: Chi^2 (df=7, n=170)=2.32; p = .940

Post-ELP test scores: ZCL4Comp vs ZCL4Exp: Chi^2 (df=7, n=170)=6.64; p = .468

Pre-ELP: before commencement of the experiential learning programme; **Post-ELP**: after completion of the experiential learning programme

ZCL4Comp: comparator cohort: **ZCL4Exp**: experimental cohort

Table 5.4
*Pre- and Post-ELP English reading comprehension scores: comparison of the mean and standard deviations **between** each cohort*

Mean English Reading Comprehension scores obtained between cohorts	Cohorts			
	ZCL4Comp		ZCL4Exp	
	Pre-ELP	Post-ELP	Pre-ELP	Post-ELP
n	67	67	102	102
Mean	74.91	73.61	73.04	72.80
Standard Deviation	12.55	12.63	14.41	16.45

Pre-ELP: ZCL4Comp vs ZCL4Exp: Student's t-test: t-value = 0.87, p = .386

Post-ELP: ZCL4Comp vs ZCL4Exp: Student's t-test: t-value = 0.34, p = .731

The mean pre-ELP test score (/100) achieved by the ZCL4Comp group (n = 67) was 74.91±12.55, compared to the mean pre-ELP test score of 73.04±14.41 achieved by the ZCL4Exp group (n = 102) (Table 5.4). Pre-ELP mean test scores between the two cohorts were similar, with no significant difference (p = .386) noted in the scores between the ZCL4Comp and ZCL4Exp groups prior to commencement of the ELP (Student's t-test, t-value = 0.87, n = 169).

Post-ELP, the mean test scores were 73.61±12.63 for the ZCL4Comp group, and 72.80±16.45 for the ZCL4Exp group (Table 5.4). Again, no significant difference (p = .731) was found between the two cohorts in terms of the post-ELP mean test scores (Student's t-test, t-value = 0.34, n = 169) (Table 5.4).

When the mean test scores were compared ***within*** each cohort (Table 5.5), no significant difference (p = .274) was found between the mean test scores obtained pre-ELP and post-ELP in the ZCL4Comp group (Paired t-test, t-value = 1.10, n = 65). Similarly for the ZCL4Exp group, no significant difference (p = .393) was found between the mean score obtained pre-ELP and post-ELP (Paired t-test, t-value = 0.86, n = 95). Thus, within each cohort, there was no significant change in the mean English Reading Comprehension test scores over the six month research period.

Table 5.5
*Pre- and Post-ELP English reading comprehension scores: comparison of the means and standard deviations obtained **within** each cohort*

Mean English Reading Comprehension scores obtained within each cohort	Cohorts			
	ZCL4Comp		ZCL4Exp	
	Pre-ELP	Post-ELP	Pre-ELP	Post-ELP
*n	65	65	95	95
Mean	74.66	73.60	73.36	72.51
Standard Deviation	12.63	12.70	14.44	15.94

ZCL4Comp: pre-ELP vs post-ELP mean scores; Paired *t*-test: *t*-value = 1.10, *p* = .274

ZCL4Exp: pre-ELP vs post-ELP mean scores: Paired *t*-test: *t*-value = 0.86, *p* = .393

**Note:* Table 5.5 presents data using paired pre- and post-ELP test scores within each cohort, so *n* may differ from Table 5.4, which compares unpaired test scores between the two cohorts.

5.3.2 Categories of English Reading Comprehension Scores (Pre- and Post-ELP)

As described in Chapter Three (section 3.7.1.2), the English Reading Comprehension test scores were then categorised as *developing* (score between 0 and 42); *expanding* (score lies between 43 to 65); *functional* (score between 66 and 85) and *proficient* (score between 86 and 100) (Table 5.6). Ideally, a BPharm4 student should be able to achieve an English reading comprehension score in the *proficient* category, as at this level, the reader can understand passages that are relatively complex and deal with academic subject matter, often in a theoretical framework. Readers falling into the *functional* category may struggle to understand medical literature and pharmacology reference books as the reading comprehension level of *functional* is limited to understanding passages with uncomplicated organisation and ideas.

Table 5.6
Categories of English Reading Comprehension scores in the comparator and experimental cohorts

Categories of English Reading Comprehension scores	Cohorts							
	Pre-ELP				Post-ELP			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	n	%	n	%	n	%	n	%
Developing	0	0.00	2	1.96	1	1.49	6	5.88
Expanding	13	19.40	22	21.57	12	17.91	26	25.49
Functional	41	61.19	58	56.86	43	64.18	46	45.10
Proficient	13	19.41	20	19.61	11	16.42	24	23.53
Total	*67*	100.00	*102*	100.00	*67*	100.00	*102*	100.00

Pre-ELP Categories: ZCL4Comp vs ZCL4Exp: Chi^2 (df = 3, n = 169) = 1.54; p = .674
Post-ELP Categories: ZCL4Comp vs ZCL4Exp: Chi^2 (df = 3, n = 169) = 6.70; p = .082
Pre-ELP: before commencement of the experiential learning programme; **Post-ELP**: after completion of the experiential learning programme
Category Scores: **Developing**: 1 to 42; **Expanding**: 43 to 65; **Functional:** 66 to 85: **Proficient**: 86 to 100

A pre-ELP test score in the *functional* category was obtained by 61.19% (n = 67) of the ZCL4Comp group, and 56.86% (n = 102) of the ZCL4Exp group, while 19.40% (n = 67) of the ZCL4Comp group could be categorised as *proficient*, compared to 19.61% (n = 102) in the ZCL4Exp group. No significant difference was observed in the distribution of pre-ELP test scores across the four categories, when the two cohorts were compared (p = .674; Chi^2: df = 3, n = 169).

Of concern was the number of students who scored in the *expanding* or *developing* categories (14 students in the ZCL4Comp, pre-ELP group (19.40%; n = 67); 24 students (23.53%; n = 102) in the ZCL4Exp, pre-ELP group). As reported in the literature, the lower level of English reading comprehension ability could potentially impact negatively on academic achievement, both in the BPharm programme and in the ELP (Bharuthram, 2012).

Categorisation of the post-ELP scores showed a similar trend, with 64.18% of the ZCL4Comp group (n = 67) and 45.10% of the ZCL4Exp group (n = 102) achieving scores

in the *functional* category (Table 5.6). The distribution of post-ELP scores across the four categories was similar, with no significant difference found between the two cohorts (p = .082; Chi^2, df = 3, n = 169).

5.3.3 Summary

In summary, the majority of BPharm4 students in the two cohorts, post-ELP, (73.37%; n = 169) could be categorised as *proficient* or *functional* according to the English reading comprehension scores obtained. Students categorised as *developing* (seven students) or *expanding* (38 students) would be expected to struggle with the academic demands of pharmacology and therapeutics courses, which necessitate in-depth reading and understanding of the medical literature. The two cohorts were also found to be similar in terms of English reading comprehension ability, based on test scores obtained pre-ELP and post-ELP. No significant changes in the English reading comprehension scores obtained after the ELP were observed in either cohort of students, suggesting that the English reading comprehension ability did not change over the duration of the research period.

5.4 ACADEMIC ACHIEVEMENT

Several indicators were used as a measure of academic achievement in the current research. The APS provided a measure of academic achievement on entry to the university (i.e. pre-pharmacy), as it is utilised as an admission test score; the BPharm weighted average for each academic year prior to BPharm4 provided a measure of general academic achievement in the BPharm programme. The rate of academic progression through the BPharm programme was also considered in the context of the admission route. Pharmacology2 and Pharmacology3 summative November examination marks were used as a measure of academic achievement in the pharmacology discipline, while

Pharmacology4 assessment marks were used as a specific indicator of academic achievement in the ELP.

5.4.1 Admission Points Score (APS)

Admission to the four year BPharm or five year Extended BPharm programmes is guided by the Admission Points Score (APS). Entry into the BPharm programme requires an APS of ≥38, and the specific subject criteria must be met (Chapter Three, section 3.7.1.8). Borderline applicants with an APS between 35 and 37 are sent for the Access Assessment Tests, in order to determine if placement should be into the four year BPharm or five year Extended BPharm programme. Applicants who do not meet the admission requirements but have an APS between 30 and 34 are referred for testing and if they perform well, are admitted into the five year Extended BPharm programme. The APS was utilised in the current research project as a measure of academic ability pre-pharmacy, on entry to university, as the APS is calculated from the subject grades achieved in the NSC (the secondary school exit examination in South Africa).

The majority of participants (69.81%) from both comparator and experimental cohorts (n = 159) had APS scores ≥ 38, with scores above 40 achieved by 56.67% of the ZCL4Comp cohort (n = 60), and 52.53% of the ZCL4Exp group (n = 99) (Table 5.7). No significant difference (p = .874) was found in the distribution of APS scores between ZCL4Comp and ZCL4Exp cohorts (Chi^2: df = 4, n = 159). An APS score was not available for some of the international students, due to the differences in the respective country's school-leaving exit examination.

Table 5.7
Frequency distribution of Admission Point Scores in the comparator and experimental cohorts

Admission Points Score (APS)	Cohorts					
	ZCL4Comp		ZCL4Exp		ZCL4Comp & ZCL4Exp	
	n	%	n	%	n	%
≥40	34	56.67	52	52.53	86	54.09
38-39	9	15.00	16	16.16	25	15.72
35 - 37	5	8.33	9	9.09	14	8.81
30 - 34	8	13.33	18	18.18	26	16.35
below 30	4	6.67	4	4.04	8	5.03
*Total	*60*	100.00	*99*	100.00	*159*	100.00

APS Scores: ZCL4Comp vs ZCL4Exp: Chi^2 (df = 4, n = 159) = 1.22; p = .874
APS Testing Bands: BPharm (4 years): ≥ 38 = accepted; 35 to 37 = referred for Access Assessment testing for admission into 4 or 5 year BPharm; 30 to 34 = referred for testing for entry into five year Extended BPharm programme
*Note: An APS score was not available for some of the international students

The APS scores and subsequent referral for testing determines admission of students into one of the two BPharm programmes offered at NMMU. According to the BPharm registration code (Table 5.1), the majority of students in the study sample were admitted into the four year BPharm programme (89.86% of the ZCL4Comp group (n = 69) and 83.65% of the ZCL4Exp group (n = 104).

The mean APS scores were compared between the two cohorts. No significant difference (p = .767) was observed in the mean APS test scores between the ZCL4Comp and ZCL4Exp cohorts (Student's t-test: t = 0.30, n = 159) (Table 5.8).

Table 5.8
Admission Point Scores: mean and standard deviation in the comparator and experimental cohorts

Admission Points Scores (APS)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	60	99	159
Mean	39.57	39.26	39.38
Standard deviation	6.81	5.92	6.25

Student's t-test: t-value = 0.30, n = 159; p = .767
ZCL4Comp: comparator group; ZCL4Exp: experimental group

At NMMU, the only degree programmes with an APS higher than the 38 required for the BPharm degree, are the Bachelor of Science degree programmes which require an APS of 40, and specify Mathematics as a subject requirement, but not Physical Science or Natural Science (NMMU, 2016). NMMU's Mission Statement explains that "We are committed to promoting *equity of access and opportunities* so as to give students the best chance of success in their pursuit of lifelong learning and diverse educational goals" (NMMU, 2016). NMMU is situated in the Eastern Cape, one of the poorest provinces in South Africa, with numerous socio-economic factors like HIV/AIDS, poverty, high rates of unemployment, vandalism and crime impacting negatively on the quality of education received at the primary and secondary level of schooling (Lemon, 2004). Large discrepancies in the quality of pre-university education are found between the better resourced urban schools, compared to schools in the rural areas and in the city townships and informal settlements, which typically face challenges of inadequate infrastructure coupled with a lack of financial resources and strong leadership and in many cases, poorly trained and demotivated educators (Bush & Glover, 2016). Viewed in this context, the academic ability of the study sample, as indicated by the APS, would be regarded as above average and academically sound.

5.4.2 Academic achievement in the BPharm programme (prior to final year)

The weighted average of each participant's BPharm module marks, per academic year, was used as a measure of academic achievement prior to registration as a final year (BPharm4) student. The weighted average was obtained from the final module marks achieved for each academic year, namely, BPharm1, BPharm2 and BPharm3. The marks obtained for each module were weighted according to the module's credit load and the average mark for the academic year level then calculated, taking into account the BPharm registration code (20300 for the 4 year programme and 67300 for the 5 year Extended

BPharm programme) and the associated modules for each programme (Chapter Three, Table 3.5 and Table 3.6). The weighted average mark for each academic year was then used to provide a measure of academic achievement for the specific academic year level.

The distribution of the BPharm1 weighted average marks was similar between the two cohorts (p = .321; Chi^2: df = 1, n = 172), with 11.76% students in ZCL4Comp (n = 68) achieving a mark of ≥75%, compared to 17.31% in ZCL4Exp (n = 104) (Table 5.9). Likewise, for the BPharm2 weighted average mark, 4.48% of the ZCL4Comp (n = 67) achieved an average weighted mark of ≥75%, compared to 4.81% of the ZCL4Exp group (n = 104), and no significant difference (p = .719) was found between the distribution of the weighted average marks in BPharm2 between the two cohorts (Chi^2: df = 2, n = 171) (Table 5.9).

Table 5.9
Frequency distribution of BPharm1, BPharm2 and BPharm3 weighted average mark in the comparator and experimental cohorts

BPharm weighted average (%)	Cohorts																	
	ZCL4Comp						ZCL4Exp						ZCL4Comp and ZCL4Exp					
	BPharm1		BPharm2		BPharm3		BPharm1		BPharm2		BPharm3		BPharm1		BPharm2		BPharm3	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0 to 49	0	0	0	0	0	0	0	0	1	0.96	3	2.88	0	0.00	1	0.58	3	1.73
50 to 74	60	88.24	64	95.52	62	89.86	86	82.69	98	94.23	95	91.35	146	84.88	162	94.74	143	90.75
75 to 100	8	11.76	3	4.48	7	10.14	18	17.31	5	4.81	6	5.77	26	15.12	8	4.68	13	7.52
Total	68	100.00	67	100.00	69	100.00	104	100.00	104	100.00	104	100.00	172	100.00	171	100.00	173	100.00

BPharm1: ZCL4Comp vs ZCL4Exp: Chi^2 (d*f* = 1, *n* = 172) = 0.98; *p* = .321
BPharm2: ZCL4Comp vs ZCL4Exp: Chi^2 (d*f* = 2, *n* = 171) = 0.66; *p* = .719
BPharm3: ZCL4Comp vs ZCL4Exp: Chi^2 (d *f*= 2, *n* = 173) = 3.06; *p* = .217
ZCL4Comp: comparator group: ZCL4Exp: experimental group.

Similarly, for the BPharm3 weighted averages, no significant difference was observed in the distribution of the marks between the two cohorts (p = .217; Chi^2: df = 2, n = 173), with 10.14% of the ZCL4Comp (n = 69) achieving a mark of ≥ 75%, compared to 5.77% of the ZCL4Exp cohort (n = 104) (Table 5.9).

The findings suggest that the two cohorts in the study sample were evenly matched in terms of academic ability. This result is in agreement with the distribution of APS test scores and provides evidence that the two cohorts did not differ significantly in terms of overall academic achievement.

The difference in the means of the BPharm1 weighted average between ZCL4Comp and ZCL4Exp was 2.40% (Table 5.10), with a statistically significant but small practical difference observed between the two cohorts in terms of the mean mark (p = .043; Student's t-test: t = -2.04, n = 172, Cohen's d = 0.32).

Table 5.10
BPharm weighted average means and standard deviations for the comparator and experimental cohorts

BPharm weighted average (%)	Cohorts								
	ZCL4Comp			ZCL4Exp			Combined		
	Academic year of BPharm degree								
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
n	68	67	69	104	104	104	172	171	173
Mean	64.95	60.87	65.33	67.35	62.67	63.01	66.40	61.96	63.94
Standard Deviation	7.38	6.12	7.20	7.64	6.85	7.05	7.61	6.62	7.18

BPharm1: ZCL4Comp vs ZCL4Exp: Student's t-test: t-value = -2.04, p = .043; Cohen's d = 0.32
BPharm2: ZCL4Comp vs ZCL4Exp: Student's t-test: t-value= -1.75, p = .082;
BPharm3: ZCL4Comp vs ZCL4Exp: Student's t-test: t-value= 2.10, p = .037; Cohen's d = 0.33
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort

No significant difference was found in the mean BPharm2 weighted average between the ZCL4Comp and ZCL4Exp cohorts, with a difference in the mean of 1.80% (p = .082; Student's t-test: t = -1.75, n = 171). The mean BPharm3 weighted average mark again showed a statistically significant difference, but small practical significance between

the two cohorts, where the mean mark differed by 2.32% (p = .037; Student's t-test: t = 2.10, n = 173, Cohen's d = 0.33).

The finding again provides evidence of the similarity between students in the two cohorts in terms of academic ability. This was important to establish in order to make comparisons between students from two consecutive academic years, as required by the quasi-experimental research design.

5.4.3 Academic progression

The rate of academic progression through the two BPharm programmes was determined by consideration of the BPharm registration code, year of first registration as a BPharm student and the number of years taken to progress to BPharm4, specifically registration for the Pharmacology4 module. Only 59.30% of participants (n = 172) reached the final year of the BPharm programme within the minimum time period (i.e. within 3 years for the BPharm programme, and within four years for the Extended BPharm programme) (Table 5.11). No significant difference (p = .523) was found in the rate of academic progression through the BPharm programme between the two cohorts, with 56.52% of the ZCL4Comp (n = 69) registering as BPharm4 students within the minimum time period, and 61.17% of the ZCL4Exp (n = 103) cohort (Chi^2: df = 3, n = 172) (Table 5.11).

The average rate of academic progression to the final year of the BPharm programme was 3.84±1.47 years for the ZCL4Comp cohort, compared to 3.69±0.87 years for the ZCL4Exp group (Table 5.12). No significant difference (p = .400) was observed between the two cohorts with respect to the average rate of progression through the BPharm programme (Student's t-test: t-value = 0.84, n = 172).

Table 5.11
Academic progression rates in the BPharm programme, for the comparator and experimental cohorts

Academic Progression (ie number of years taken to complete BPharm1, 2 and 3)	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	n	%	n	%	n	%
Within the minimum period	39	56.52	63	61.17	102	59.30
1 additional year	22	31.88	30	29.13	52	30.23
2 additional years	4	5.80	8	7.77	12	6.98
≥ 3 additional years	4	5.80	2	1.94	6	3.49
Total	*69*	100.00	*103*	100.00	*172*	100.00

ZCL4Comp vs ZCL4Exp: Chi^2 (df = 3, n = 172) = 2.24; p = .523
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort

Table 5.12
Rate of academic progression through BPharm1, 2 and 3: mean and standard deviation in the comparator and experimental cohorts

Rate of academic progression (years)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	69	103	172
Mean	3.84	3.69	3.75
Standard Deviation	1.47	0.87	1.15

ZCL4Comp vs ZCL4Exp: Student's *t*-test: *t*-value = 0.84, n = 172; p = .400
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort

5.4.4 Academic achievement in Pharmacology (prior to final year)

The mark obtained for the summative November written examination papers was used as the measure of academic achievement in Pharmacology2 and Pharmacology 3, which are both year-long modules. Academic progression in pharmacology relies on the students achieving 50% or more in the module, thus Pharmacology2 is a prerequisite module for Pharmacology3, which must subsequently be passed (≥ 50%) before enrolling for Pharmacology4. The final module mark in Pharmacology2 and Pharmacology3 is calculated from the summative written November examination mark (contributes 66.67%) and the class mark (contributes 33.33%). The Pharmacology2 and Pharmacology3 summative examination papers each consisted of a 100 mark, 3 hour written paper,

utilising a combination of multiple choice and short answer questions, using the traditional closed book exam format. The summative written Pharmacology2 November examination mark was selected as the indicator of academic achievement in Pharmacology2 as it reflects the individual ability of students, as opposed to the class mark, which includes marks derived from group work assignments and practical assessments. The same principle was applied for academic achievement in Pharmacology3.

5.4.4.1 Academic achievement in Pharmacology2

The distribution of Pharmacology2 November summative assessment marks in the ZCL4Comp and ZCL4Exp cohorts was found to be similar (p = .690; Chi^2: df = 2, n = 173). The majority (59.42%) of ZCL4Comp students (n = 69) achieved a mark between 50 and 74%, compared to 52.88% of the ZCL4Exp cohort (n = 104) (Table 5.13). The assessment marks utilised were for the first registration for the Pharmacology2 module, and it can be seen that 41.04% (n = 173) of the students did not pass the written Pharmacology2 summative assessment examination on the first attempt (Table 5.13). However, students may have subsequently passed the module when the class mark was included in the final calculation of the Pharmacology2 module mark, or, qualified for a supplementary examination.

The mean mark (%) obtained in the summative Pharmacology2 examination was 52.10±12.53% for the ZCL4Comp cohort (n = 69) and, 52.52±11.50% for the ZCL4Exp cohort (n = 104). No significant difference (p = .822) was observed in the mean Pharmacology2 November exam mark between the two cohorts (Student's t-test, t-value = 0.23, n =173) (Table 5.14). The finding provides evidence that the two cohorts were academically at a very similar level in the Pharmacology2 module.

Table 5.13

Frequency distribution of Pharmacology2 November (summative) exam marks in the comparator and experimental cohorts

Pharmacology2 written summative November Examination mark (%)	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	n	%	n	%	n	%
0 to 49	26	37.68	45	43.27	71	41.04
50 to 74	41	59.42	55	52.88	96	55.49
75 to 100	2	2.90	4	3.85	6	3.47
Total	*69*	*100.00*	*104*	*100.00*	*173*	*100.00*

Pharmacology2: ZCL4Comp vs ZCL4Exp: Chi^2 (d*f* = 2, *n* = 173) = 0.74; *p* = .690
ZCL4Comp: comparator cohort; **ZCL4Exp**: experimental cohort

Table 5.14

Pharmacology2 November summative assessment marks: comparison of mean and standard deviation for comparator and experimental cohorts

Pharmacology2 written summative November Examination mark (%)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	69	104	173
Mean	52.10	52.52	52.35
Standard Deviation	12.53	11.50	11.89

ZCL4Comp vs ZCL4Exp: Student's *t*-test: *t*-value = 0.23, *n* = 173; *p* = .822
ZCL4Comp: comparator group; ZCL4Exp: experimental group

5.4.4.2 Academic achievement in Pharmacology3

No significant difference (*p* = .357) was found in the distribution of Pharmacology3 November summative assessment marks between the ZCL4Comp and ZCL4Exp cohorts (Chi^2: d*f* = 2, *n* = 173). The majority of students (72.46% of the ZCL4Comp group (*n* = 69) and 68.27% of the ZCL4Exp cohort (*n* = 104)), achieved a mark between 50 and 74% (Table 5.15). As with the Pharmacology2 mark, the Pharmacology3 mark used for the purposes of the research was the mark achieved on the first attempt at the summative Pharmacology3 November examination. The overall pass rate for Pharmacology3 (Table 5.15) was higher than for Pharmacology2 (Table 5.13), with 28.48% students from both cohorts (*n* = 173) not obtaining a pass mark of ≥ 50% on

the first attempt at the written Pharmacology3 summative assessment. The reason for the apparent improvement in the pass rate in Pharmacology3 is likely to be a consequence of Pharmacology2 being a pre-requisite for Pharmacology3, so students who did not manage to pass Pharmacology2 with a mark ≥ 50%, would have to repeat the Pharmacology2 module and would not be able to register for Pharmacology3.

Table 5.15
Frequency distribution of Pharmacology3 November (summative) exam marks in the comparator and experimental cohorts

Pharmacology3 summative November mark (%)	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	n	%	n	%	n	%
0 to 49	18	26.09	33	31.73	51	29.48
50 to 74	50	72.46	71	68.27	121	69.94
75 to 100	1	1.45	0	0.00	1	0.58
Total	*69*	*100.00*	*104*	*100.00*	*173*	*100.00*

Pharmacology3: ZCL4Comp vs ZCL4Exp: Chi^2 (d*f* = 2, *n* = 173) = 2.06; *p* = .357
ZCL4Comp: comparator group; ZCL4Exp: experimental group

Table 5.16
Pharmacology3 November summative assessment marks: comparison of mean and standard deviation for comparator and experimental cohorts

Pharmacology3 Summative November Exam (%)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	69	104	173
Mean	54.58	53.87	54.15
Standard Deviation	9.93	8.76	9.23

ZCL4Comp vs ZCL4Exp: Student's *t*-test: *t*-value= -0.50, *n* = 173; *p* = .619
ZCL4Comp: comparator group; ZCL4Exp: experimental group

The mean mark (%) obtained in the summative Pharmacology3 November examination was 54.58±9.93% for the ZCL4Comp cohort (*n* = 69) and, 53.87±8.76% for the ZCL4Exp cohort (*n* = 104) (Table 5.16). No significant difference *(p* = .619) was found

in the mean Pharmacology3 November exam mark between the two cohorts (Student's *t*-test, *t*-value = - 0.50, *n* = 173).

5.4.5 Academic achievement in Pharmacology4

The average mark obtained for the two summative November examination papers was used as the measure of academic achievement in Pharmacology4 and the ELP. The Pharmacology4 assessment papers utilise an open book case study-based format, and each paper consists of three clinical case studies (10 marks each) using a time frame of 1 hour and 15 minutes per case study, so an examination paper is written over 3 hours and 45 minutes (Appendix C provides an example of a Pharmacology4 summative examination paper). A penalty system is applied when marking the clinical case assessments whereby 2 marks are deducted from the case test score (/10) if an irrational or illogical decision is made, and a zero mark is allocated if a decision is made that is life-threatening to the patient. Application of the penalty means that a student may achieve a score of zero marks for one or more of the clinical case studies.

Two sets of Pharmacology4 marks were used for the research: the first formative Pharmacology4 assessment mark; and, the final summative Pharmacology4 November examination mark. The first Pharmacology4 formative assessment mark was included for comparison purposes, in order to establish the level of academic achievement of students in the two cohorts, using the same assessment paper (written before the intervention was implemented for the ZCL4Exp in Phase Two). Identical Pharmacology4 open book, clinical case study-based assessment papers were written by students from both cohorts, at the same stage of the ELP, in order to exclude variations in the level of difficulty of the assessments. Comparisons of marks achieved by the two cohorts of students could then be made (Chapter Three, section 3.7.1.6).

Pharmacology4 first formative assessment marks

The Pharmacology4 first formative assessment marks were obtained pre-ELP (i.e. the assessment was written early in the academic year, once every Pharmacology4 student had completed two clinical rotations in the ELP). The results clearly illustrate the initial difficulties experienced by students in both cohorts (Table 5.17), with the majority of students (73.41%; n = 173) from both cohorts obtaining a mark below 50%. No significant difference (p = .051) was found in the distribution of formative assessment marks between the two cohorts (Chi^2: df = 2, n = 173).

Table 5.17
Frequency distribution of Pharmacology4 first formative assessment mark in the comparator and experimental cohorts

Pharmacology4 first formative assessment mark (%)	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	n	%	n	%	n	%
0 to 49	54	78.26	73	70.19	127	73.41
50 to 74	10	14.49	27	25.96	37	21.39
75 to 100	5	7.25	4	3.85	9	5.20
Total	69	100.00	104	100.00	173	100.00

ZCL4Comp vs ZCL4Exp: Chi^2 (df = 2, n = 173) = 5.97; p = .051
ZCL4Comp: comparator group; ZCL4Exp: experimental group

No significant difference (p = .095) was found in the mean mark obtained in the first formative assessment for Pharmacology4 when comparisons were made between ZCL4Comp (29.71±22.58%), and the ZCL4Exp cohort (35.05±18.90%) (Student's t-test, t-value = -1.68, n = 173) (Table 5.18). The results suggest that students from the two cohorts were at the same level academically, in terms of problem solving and clinical decision making ability, as the ELP commenced, which would therefore allow comparisons to be made.

Table 5.18
Pharmacology4 first formative assessment marks: comparison of mean and standard deviation for comparator and experimental cohorts

Pharmacology4 first formative assessment (%)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	69	104	173
Mean	29.71	35.05	32.92
Standard Deviation	22.58	18.90	20.66

Student's *t*-test: *t*-value = -1.68, *n* = 173; *p* = .095
ZCL4Comp: comparator group; ZCL4Exp: experimental group

Pharmacology4 final summative assessment marks

The Pharmacology4 final summative assessment was obtained on completion of the ELP and Pharmacology4 module, using the average of the marks obtained for the two November written summative examination papers. An increased percentage of students (51.16%) from the combined two cohorts (*n* = 172) achieved a mark of ≥ 50% in the Pharmacology4 summative assessment, compared to 26.59% (*n* = 173) in the first formative Pharmacology4 assessment (Table 5.19).

No significant difference (*p* = .161) was noted in the distribution of the Pharmacology4 summative assessment marks between the ZCL4Comp and ZCL4Exp groups (Chi^2, d*f* = 2, *n* = 172).

The results therefore suggest the intervention introduced in Phase Two, did not significantly influence the distribution of summative Pharmacology4 marks in the experimental cohort.

Table 5.19
Frequency distribution of Pharmacology4 summative November exam mark in the comparator and experimental cohorts

Pharmacology4 summative November exam mark (%)	Cohorts					
	ZCL4Comp		ZCL4Exp		Total	
	n	%	n	%	n	%
0 to 49	39	56.52	45	43.69	84	48.84
50 to 74	28	40.58	50	48.54	78	45.35
75 to 100	2	2.90	8	7.77	10	5.81
Total	69	100.00	103	100.00	172	100.00

Summative Pharmacology4 marks: ZCL4Comp vs ZCL4Exp: Chi^2 (d*f*=2, *n* = 172) = 3.66; *p* = .161
ZCL4Comp: comparator group; **ZCL4Exp**: experimental group; Total: combined cohorts

The mean mark (%) obtained in the summative Pharmacology4 November examination was 46.50±15.18% for the ZCL4Comp cohort (*n* = 69) and, 51.63±14.95% for the ZCL4Exp cohort (*n* = 103) (Table 5.20).

Table 5.20
Final summative Pharmacology4 November exam mark: comparison of mean and standard deviation for comparator and experimental cohorts

Pharmacology4 summative November exam mark (%)	Cohorts		
	ZCL4Comp	ZCL4Exp	Combined
n	69	103	172
Mean	46.50	51.63	49.57
Standard Deviation	15.18	14.95	15.21

Student's *t*-test: *t*-value= -2.20, n = 172; *p* = .030; Cohen's *d* = 0.34
ZCL4Comp: comparator group; ZCL4Exp: experimental group

The mean Pharmacology4 summative assessment mark obtained by ZCL4Exp students (51.63±14.95%) was significantly higher (*p* = .030) than the mean mark obtained by the ZCL4Comp students (46.50±15.18%, Student's *t*-test, *t*-value = -2.20, *n* =172) (Table 5.20). The difference in the mean mark achieved by ZCL4Exp, when compared to ZCL4Comp, was of small practical significance (Cohen's *d* = 0.34), with a 5.13% difference in the means obtained by ZCL4Comp and ZCL4Exp cohorts. Prior to the

intervention, there was no significant difference (p = .095) noted in the mean Pharmacology4 first formative assessment marks between the two cohorts (Student's *t*-test: *t*-value = -1.68, n = 173). The results therefore show a statistically significant but small practically significant difference in the mean Pharmacology4 summative assessment marks observed between the ZCL4Comp and ZCL4Exp, suggesting that the intervention may have influenced academic achievement in the ZCL4Exp cohort.

Both cohorts demonstrated significant increases in the mean mark obtained for the Pharmacology4 assessment, when the first formative mark was compared to the summative Pharmacology4 mark (Table 5.21).

Table 5.21
Comparison of first formative and summative Pharmacology4 assessment marks: comparison of mean and standard deviation for comparator and experimental cohorts

	Cohorts			
	ZCL4Comp		ZCL4Exp	
	Mean Pharmacology4 assessment marks (%)			
	First formative	Summative	First formative	Summative
n	69	69	103	103
Mean	29.71	46.50	34.84	51.63
Standard deviation	22.58	15.18	18.87	14.95

ZCL4Comp: formative vs summative Pharmacology4 mean:
paired *t*-test: *t*-value = -6.88, n = 69; p < .001, Cohen's d = 0.83

ZCL4Exp: formative vs summative Pharmacology4 mean:
paired *t*-test: *t*-value = -8.17, n = 103; p < .001, Cohen's d = 0.81

ZCL4Comp: comparator group; ZCL4Exp: experimental group

The mean Pharmacology4 assessment mark in the ZCL4Comp group (n = 69), showed a practically significant increase (p < .001), from 29.71±22.58% for the formative Pharmacology4 assessment, to 46.50±15.18% for the summative Pharmacology4 assessment (paired *t*-test, *t*-value = -6.88, n = 69, Cohen's d = 0.83). Likewise, for the ZCL4Exp cohort (n = 103), the mean Pharmacology4 assessment mark showed a

practically significant increase ($p < .001$) from 34.84±18.87% (formative assessment) to 51.63±14.95% (paired *t*-test, *t*-value = -8.17, $n = 103$, Cohen's $d = 0.81$).

5.4.6 Summary

The APS, as the admission test score which guides placement in the BPharm programme at NMMU, can be compared to the PCAT, which has been researched extensively as a predictor of academic achievement in pharmacy programmes in USA (Kuncel et al., 2005). The results found no significant difference between the two cohorts in terms of academic ability when measured using the APS on admission to NMMU. The APS scores also suggested that the academic ability of the study sample can be viewed as above average in the context of undergraduate tertiary level education at NMMU.

The weighted average mark for each academic year in the BPharm programme was used to provide a measure of academic achievement for the specific academic year level, and as such, is comparable to GPA, which has been extensively investigated as a predictor of academic performance in pharmacy programmes (Giuliano, Gortney, & Binienda, 2016; Kidd & Latif, 2003; Kuncel et al., 2005; McCall et al., 2006; Naing, Yusoff, Nam Yeoh, & Pook, 2013; Schlesselman & Coleman, 2011). The academic performance of the study sample, namely students from the comparator and experimental cohorts, was found to be similar with respect to the distribution of marks and the mean mark for the weighted average marks for BPharm1, BPharm2 and BPharm3.

Results describing the rate of academic progression highlighted that difficulties were experienced by many of the participants in the study sample, with only 59.30% of participants ($n = 172$) progressing to the final year of the BPharm programme within the minimum time period (i.e. within 3 years for the BPharm programme, and within four years for the Extended BPharm programme).

The results provided substantial evidence that the two cohorts were academically at a very similar level in Pharmacology2, Pharmacology3 and Pharmacology4, which enabled comparisons to be conducted between the comparator and experimental cohorts. For the purpose of the research, academic achievement in pharmacology focused on the individual student performance in written assessments, rather than the final module mark, which is influenced by group-based assessments in practical sessions and assignments.

5.5 RAVEN'S SPM AND PROBLEM SOLVING ABILITY

Raven's SPM was discussed in Chapter Two (section 2.5.2.1), and has been used to measure a person's capacity to think clearly, with the total score providing a measure of intelligence (Raven et al., 2000). Raven's SPM has also been utilised as a measure of nonverbal reasoning ability (Lynn et al., 2004), hence its inclusion in this study as a measure of problem solving ability linked to clinical reasoning.

Raven's SPM was administered pre- and post-ELP in Phase One and Phase Two, to both comparator and experimental cohorts. The paper-based tool was administered under test conditions, with no time limit imposed (Chapter Three, section 3.7.1.3). The SPM consists of five sub-sets of 12 questions, contributing to a total maximum score of 60. The scores obtained are reported relative to the percentage of a reference group of the same age (Raven et al., 2000). For the purposes of the current research, the reference group used was the 1992 Smoothed British Norms for the Self-Administered Test Completed at Leisure (source: Table SPM8 in Raven Manual Section 3: Standard Progressive Matrices), in which the reference group population used were adults from Dumfries, in Scotland (Raven et al., 2000). The test scores from both cohorts were also categorised from Grade I (intellectually superior, scoring on or above the 95^{th} percentile), to Grade V (intellectually impaired, scoring on or below the 5^{th} percentile).

5.5.1 Comparison of Raven's SPM test scores in ZCL4Comp and ZCL4Exp groups

Raven's SPM was administered pre-ELP to both the ZCL4Comp (n = 69) and ZCL4Exp (n = 106) groups. The mean total test score (/60) obtained by the ZCL4Comp group was 49.28±4.95 and, 50.61±5.13 for the ZCL4Exp cohort, with a difference in the means of 1.33%. The pre-ELP mean total test score (/60) for both cohorts was found to be similar, with no significant difference (p = .089) noted between the two cohorts (Student's t-test: t-test, t-value = -1.71, n = 175) (Table 5.22).

Table 5.22
Differences in the mean Raven's SPM scores obtained pre- and post-ELP in the comparator and experimental groups

Raven's SPM Scores	Cohorts							
	Pre-ELP				**Post-ELP**			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Set A (/12)	11.28	0.92	11.43	0.97	11.74	0.54	11.36	1.06
Set B (/12)	11.25	1.12	11.23	1.25	11.57	0.68	11.26	1.46
Set C (/12)	9.65	1.55	10.26	1.58	10.29	1.34	10.36	1.57
Set D (/12)	10.23	1.21	10.42	1.24	10.46	1.23	10.33	1.38
Set E (/12)	6.87	2.09	7.27	2.32	7.06	2.23	7.26	2.60
Total (/60)	49.28	4.95	50.61	5.13	51.12	4.48	50.57	6.07
Sample size	69		106		68		84	

Pre-ELP: ZCL4Comp vs ZCL4Exp (n = 175): Student's t-test: Set A; t-value = -1.08, p = .282: Set B; t-value = 0.11, p = .915: Set C: t-value = -2.52, p = .013, Cohen's d = 0.39; Set D: t-value = -0.96, p = .337; Set E: t-value = -1.17, p = .244; Total: t-value = -1.17, p = .089
Post-ELP: ZCL4Comp vs ZCL4Exp (n = 152): Student's t-test: Set A; t-value = -2.68, p = .008, Cohen's d = 0.44; Set B; t-value = 1.63, p = .106; Set C: t-value = - 0.26, p = .793; Set D: t-value = 0.57,
p = .569; Set E: t-value = - 0.51, p = .610; Total: t-value = 0.62, p = .538
ZCL4Comp: Pre-ELP vs Post-ELP (n = 68): Paired t-test: Total: t-value = - 4.88, p < .001, Cohen's d = 0.59;
ZCL4Exp: Pre-ELP vs Post-ELP (n = 81): Paired t-test: Total: t-value = 0.58, p = .566
SD: Standard deviation; ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort.

On completion of the ELP, Raven's SPM was re-administered to both ZCL4Comp (n = 68) and ZCL4Exp (n = 84) cohorts. The post-ELP mean total test score (/60) obtained by the ZCL4Comp group was 51.12±4.48 and 50.57±6.07 for the ZCL4Exp cohort, with a difference in the means of 0.55%. No significant difference (p = .538) was observed

in the post-ELP mean total test scores (/60) for both cohorts (Student's *t*-test, *t*-value = 0.62, *n* = 152) (Table 5.22). Thus the mean total test scores obtained pre- and post-ELP were deemed to be similar *between* the two cohorts.

On comparison of the pre-and post-ELP test scores *within* each cohort (Table 5.22), a practically significant difference ($p < .001$) was found between the pre-ELP and post-ELP mean total test scores in the ZCL4Comp group (paired *t*-test, *t*-value = -4.88, *n* = 68, Cohen's *d* = 0.59). In comparison, no significant difference ($p = .566$) was found between the pre- and post-ELP mean test scores in the ZCL4Exp group (paired *t*-test, *t*-value = 0.58, *n* = 81).

On closer examination of the subsets of pre-ELP Raven's SPM scores, only subset C scores showed a significant difference ($p = .013$) between the mean score (/12) obtained by ZCL4Comp (9.65±1.55) compared to ZCL4Exp (10.26±1.58), with small practical significance (Student's *t*-test: *t*-value= -2.52, *n* = 175, Cohen's *d* = 0.39) (Table 5.22). In the post-ELP results, only the subset A scores (/12) showed a significant difference ($p = .008$) between the mean obtained by ZCL4Comp (11.74±0.54) and ZCL4Exp (11.36±1.06), again with small practical significance (*t*-test: *t*-value = 2.68, *n* = 152, Cohen's *d* = 0.44) (Table 5.22).

5.5.2 Comparison of Grade categories of Raven's SPM test scores in ZCL4Comp and ZCL4Exp groups

The scores obtained by the two cohorts were compared to the 1992 British norms, and were categorised into grades as described by Raven et al. (2000) (Table 5.23).

Table 5.23
Grades of Raven's SPM scores as sourced from Raven et al. (2000)

Grade	Category	Percentile	Score
I	*Intellectually superior* If the score lies at or above the 95th percentile for people of the same age group	≥ 95th	≥ 59
II	*Definitely above the average in intellectual capacity* If the score lies at or above the 75th percentile (may be designated II+ if score lies on or above the 90th percentile)	≥ 75th but below 95th	≥ 57 but below 59
III	*Intellectually average* If the score lies between the 25th and 75th percentile (may be designated III+ if it is above the 50th percentile and III- if below)	≥ 25th but below 75th	≥ 49 but below 57
IV	*Definitely below average in intellectual capacity* If the score lies on or below the 25th percentile (may be designated IV- if it lies on or below the 10th percentile)	≤ 25th but above 5th	> 39 but below 49
V	*Intellectually impaired* If the score lies on or below the 5th percentile for that age group	≤ 5th	0 to 39

Table 5. 24
Frequency distribution of Raven's SPM Grades in the comparator and experimental groups

Raven's SPM Grade*	Cohorts							
	Pre-ELP				**Post-ELP**			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	n	%	n	%	n	%	n	%
I (≥59)	0	0.00	2	1.89	2	2.94	1	1.19
II (57 or 58)	3	4.35	9	8.49	6	8.82	7	8.33
III (≥ 49 to 56)	42	60.87	66	62.26	43	63.24	54	64.29
IV (>39 to 48)	22	31.88	27	25.47	17	25.00	20	23.81
V (0 to 39)	2	2.90	2	1.89	0	0.00	2	2.38
Sample size	*69*	100.00	*106*	100.00	68	100.00	*84*	100.00

Pre-ELP: ZCL4Comp vs ZCL4Comp: Chi^2 (*df* =4, *n* = 175) =3.16; *p* = .531
Post-ELP: ZCL4Comp vs ZCL4Exp: Chi^2 (*df* =4, *n* = 152) =2.24; *p* = .691
*Note: Raven's SPM Grade is based on the total score obtained (/60)

Prior to commencement of the ELP, 65.22% *(n* = 69) of the ZCL4Comp group achieved a total test score (/60) in Grade III (≥ 49 and 56) or Grade II (57 or 58), with no scores in the "intellectually superior" category of Grade I (59 or 60) (Table 5.24). In comparison, 70.75% (*n* = 106) of the ZCL4Exp group obtained a total test score in Grade II or Grade III, with two students (1.89%; *n* = 106) achieving a score in the Grade 1 category (Table 5.24). No significant difference (*p* = .531) was found between the two cohorts in terms of the distribution of total test scores across the five grades (Chi^2, d*f* = 4, *n* = 175). An unexpected finding was four students (2.29%) from the two cohorts scoring in the Grade V category (intellectually impaired). The result needs to be considered in the context in which the test was written. These four students were final year BPharm students who had progressed to the final year of the BPharm programme. Test scores in this category can, therefore, be assumed to be inaccurate and probably reflect a lack of student interest in the voluntary testing, rather than the students' academic ability. The outliers were not discarded as the researcher could not substantiate the assumption made. Another result which warrants further investigation is that 28.00% of the study sample (*n* = 175) obtained mean total test scores in the category of Grade IV (below average intellectual capacity). Previous research has shown racial differences in Raven's test scores (Rushton & Skuy, 2001; Rushton et al., 2002). However, due to the fact that race was not included as a variable during the data collection process in the current research, no further investigation was conducted.

On completion of the ELP, two students (2.94%; *n* = 68) in the ZCL4Comp group obtained a total test score in Grade I, with 72.06% (*n* = 68) of total test scores categorised as Grade III or II (Table 5.24). Only one student (1.19%; *n* = 84) in the ZCL4Exp group obtained a Grade I total test score, with 72.62% students (*n* = 84) achieving total test scores in the Grade II and III categories. Again, 24.34% of students from the two cohorts (*n* =

152) scored in the category of Grade IV, with a further two students (2.38%) in ZCL4Exp obtaining a very low score in the category Grade V. The same assumptions described in the results of the pre-ELP Raven's SPM test scores would apply. No significant difference (p = .691) was found between the two cohorts in terms of the distribution of total test scores across the five grades (Chi^2, df = 4, n = 152) (Table 5.24).

5.5.3 Summary

The results demonstrate that the two cohorts within the study sample were similar in terms of the mean Raven's SPM total test scores achieved pre- and post-ELP as well as in the distribution of the scores across the five grades. When viewing the scores as a measure of academic ability, the presence of lower scores in the categories of Grade IV or V warrant further investigation.

In the context of the current research, Raven's SPM was administered as an indicator of problem solving ability, in order to measure any change in problem solving ability during the ELP. An unexpected finding was encountered in that the pre- and post-ELP mean total test scores *within* the ZCL4Comp group showed a practically significant difference (p < .001; Paired t-test: t-value = -4.88, n = 68, Cohen's d = 0.59), yet no significant difference was observed when pre- and post-ELP mean total test scores within the ZCL4Exp group were compared (p = .566; Paired t-test: t-value = 0.58, n = 81).

5.6 LEARNING STYLES

Kolb's LSI was administered to both cohorts, before commencement and on completion of the ELP, in order to determine the individual learning styles of the final year pharmacy students. As described in Chapter Two (section 2.5.2.6), Kolb's LSI determines an individual's preference for the two processes of grasping and transforming information,

in terms of concrete (CE) versus abstract (AC), and action (AE) versus reflection (RO). A score is assigned (from 1 to 48) for each of the four concepts in order to determine an overall dominant learning style which could be diverger (CE and RO), assimilator (AC and RO), converger (AC and AE) or accommodator (CE and AE) (D. Kolb, 1984).

5.6.1 Learning styles in the ZCL4Comp and ZCL4Exp cohorts

Pre- ELP, the dominant learning style in the ZCL4Comp group (n = 65) was that of assimilator (50.77%), followed by converger (24.62%). Assimilator (41.84%) was also the dominant learning style in the ZCL4Exp group (n = 98), again followed by converger (28.57%) (Table 5.25). There was no significant difference (p = .728) in the distribution of the pre-ELP four learning styles within the ZCL4Comp cohort when compared to the ZCL4Exp cohort (Chi^2:df = 3, n = 163) (Table 5.25).

Table 5.25
Frequency distribution of Learning Styles in the comparator and experimental cohorts

Kolb LSI Learning Style	Cohorts							
	Pre-ELP				**Post-ELP**			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	n	%	n	%	n	%	n	%
Accommodator	6	9.23	10	10.20	5	8.47	18	18.00
Assimilator	33	50.77	41	41.84	25	42.37	34	34.00
Converger	16	24.62	28	28.57	22	37.29	33	33.00
Diverger	10	15.38	19	19.39	7	11.86	15	15.00
Sample size	*65*	100	*98*	100	*59*	100.00	*100*	100.00

Pre-ELP: ZCL4Comp vs ZCL4Exp: Chi^2 (df = 3, n = 163) = 1.30; p = .728

Post-ELP :ZCL4Comp vs ZCL4Exp: Chi^2 (df = 3, n = 159) = 3.49; p = .322

ZCL4Comp: comparator group; ZCL4Exp: experimental group

Post-ELP, Kolb's LSI was re-administered to both cohorts. The predominant learning style seen in the ZCL4Comp group (n = 59) was assimilator (42.37%), followed by converger (37.29%). A shift in the learning style distribution occurred post-ELP with a greater percentage of students (37.29%) in post-ELP ZCL4Comp group demonstrating the

converger learning style, compared with pre-ELP (24.62%). This trend was also observed in the ZCL4Exp group (n = 100). In the ZCL4Exp group, the predominant learning style post-ELP was also found to be assimilator (34.00%), although the percentage had decreased from 41.84% in the pre-ELP testing. An increased percentage of students (33.00%) in the ZCL4Exp group now demonstrated the converger learning style psot-ELP. No significant difference (p = .322) was found post-ELP in the distribution of the learning styles between the ZCL4Comp and ZCL4Exp groups (Chi^2: df = 3, n = 159) (Table 5.25).

5.6.2 Learning modes in the ZCL4Comp and ZCL4Exp cohorts

The mean scores obtained from Kolb's LSI were then categorised according to the four learning modes (Table 5.26), specifically the concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC) and active experimentation (AE). The learning modes form the basis of the classification of the Kolb's learning styles (D. Kolb, 1985) into diverger (CE and RO), assimilator (AC and RO), the converger (AC and AE) and the accommodator (CE and AE) (Chapter Two, Table 2.2).

Prior to commencement of the ELP, no significant difference was found in the mean scores obtained for all four learning modes when ZCL4Comp was compared to ZCL4Exp, i.e. concrete experience (CE) (p = .466, Student's t-test: t-value = 0.73, n = 163), reflective observation (RO) (p = .442, Student's t-test: t-value = 0.77, n = 163), abstract conceptualisation (AC) (p = .909, Student's t-test: t-value =-0.12, n = 163) and active experimentation (AE) (p = .862, Student's t-test: t-value = 0.17, n = 163) (Table 5.26).

Table 5.26
Mean and Standard Deviation of Scores for the four learning modes in Kolb's LSI in the ZCL4Comp and ZCL4Exp cohorts

Kolb LSI (/48)	Cohorts							
	Pre-ELP				**Post-ELP**			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	mean	sd	mean	sd	mean	sd	mean	sd
Concrete Experience CE	23.23	3.42	22.65	5.73	23.00	0.00	23.09	5.93
Abstract Conceptualisation AC	34.95	6.84	35.08	7.00	35.30	6.94	34.71	7.05
Active Experimentation AE	32.31	6.29	32.14	5.63	33.48	6.27	32.96	6.49
Reflective Observation RO	30.98	7.64	30.11	6.67	30.47	6.84	29.14	7.09
Sample size	*65*		*98*		*60*		*100*	

Pre-ELP: ZCL4Comp vs ZCL4Exp (n = 163); Student's t-test: CE: t-value = 0.73, p = .466; RO: t-value = 0.77, p = .442; AC: t-value =-0.12, p = .909; AE: t-value = 0.17, p = .862.
Post-ELP: ZCL4Comp vs ZCL4Exp (n = 160); Student's t-test: CE: t-value = -0.12 , p = .907; RO: t-value =1.16, p = .248; AC: t-value = 0.52, p = .607; AE: t-value = 0.50, p = .618

ZCL4Comp: comparator group; **ZCL4Exp:** experimental group; **sd:** standard deviation

Likewise, post-ELP, no significant difference was found in the mean scores for all four learning modes between the ZCL4Comp and ZCL4Exp groups, i.e. concrete experience (CE) (p = .907, Student's t-test: t-value = -0.12, n = 160), reflective observation (RO) (p = .248, Student's t-test: t-value = 1.16, n = 160), abstract conceptualisation (AC) (p = .607, Student's t-test: t-value =0.52, n = 160) and active experimentation (AE) (p = .618, Student's t-test: t-value = 0.5, n = 160) (Table 5.26).

As described by D. Kolb (1985), learning typically follows two processes. Initially, information is acquired or grasped, followed by processing of the information gained. There are two diametrically opposed approaches for these two processes (Chapter Two, Figure 2.1). Individuals then display a preference for learning, since information is initially grasped or perceived either by experiencing (concrete experience CE) or by conceptualising through analytical thought (abstract conceptualisation AC), creating the *abstract-concrete* (AC-CE) axis. Information can then transformed or processed through reflection and consideration (reflective observation RO) or active trial and error (active experimentation AE), creating the *active-reflective* (AE-RO) axis.

On closer examination of the preferences of students for the *active-reflective* or *abstract-concrete* approaches to learning (Table 5.27), a significant difference (p = .012) was noted between the pre- and post-ELP mean test scores on the *active-reflective* (AE-RO) axis in the ZCL4Exp group, although this was of small practical significance (Paired *t*-test: *t*-value = -2.06 , Cohen's d = 0.26). The finding suggests a shift in learning preferences in the ZCL4Exp group post-ELP towards active experimentation, which may be a result of exposure to the active learning strategies employed in the academic support sessions. The mean test scores pre- and post- ELP for ZCL4Comp were similar on both axes (*active-reflective* and *abstract-concrete*), and no change was seen in the ZCL4Exp group for the mean test scores obtained pre- and post-ELP on the *abstract-concrete* axis (Table 5.27).

Table 5.27
Mean and Standard Deviation of Scores for the two preferences for grasping and processing learning in Kolb's LSI in the comparator and experimental cohorts

Kolb LSI (/48)	Cohorts							
	Pre-ELP				**Post-ELP**			
	ZCL4Comp		ZCL4Exp		ZCL4Comp		ZCL4Exp	
	mean	sd	mean	sd	mean	sd	mean	sd
Abstract-Concrete (AC-CE)	11.32	8.44	12.37	11.58	12.16	6.94	11.69	11.35
Active-Reflective (AE-RO)	0.33	12.33	1.73	10.75	3.54	11.33	3.80	11.95

***Pre- vs Post-ELP**:*
AC-CE: *ZCL4Comp* (n = 57); Paired *t*-test: *t*-value = -0.91, p = .369; *ZCL4Exp (n=94)*: Paired *t*-test: *t*-value = 0.97, p = .333.
AE-RO:
ZCL4Comp (n = 57): Paired *t*-test: *t*-value = -1.90 , p = .062; *ZCL4Exp* (n = 94): Paired *t*-test: *t*-value = -2.06, p = .012, Cohen's d = 0.26.
ZCL4Comp: comparator group; ZCL4Exp: experimental group; sd: standard deviation

5.6.3 Summary

The distribution of learning styles between the two cohorts pre-ELP was found to be similar with the largest group of students scoring as assimilators (45.40%; n = 163), followed by convergers (26.99%). In the post-ELP cohorts (n = 159), similarity in the distribution of learning styles was again observed although there was an increase in the

percentage of students scoring as convergers in both cohorts (37.11% of students were assimilators; 34.59% of students were convergers).

Worth noting was the significant shift (p = .012) in learning preferences towards active experimentation observed in the ZCL4Exp group, when the pre- and post-ELP mean test scores were compared on the *active-reflective* (AE-RO) axis (Paired *t*-test: *t*-value = -2.06, p = .012, Cohen's d = 0.26), although the finding was of small practical significance.

5.7 WORK EXPERIENCE IN A PHARMACY ENVIRONMENT PRIOR TO THE ELP

In Phase One and Phase Two, participants completed a pre-ELP questionnaire-based survey, in order to gather demographic information from the sample. Students were asked to provide information on previous work experience completed in a pharmacy-related work environment, prior to commencement of the ELP. The responses obtained provide an overview of the extent of experiential learning that had occurred in a pharmacy work environment, prior to BPharm4, as this exposure may have contributed to academic achievement in the ELP (Table 5.28).

All of the participants (100%) from both cohorts (n = 173) indicated that they had work experience in a pharmacy-related work environment.

Table 5.28

Pharmacy related work experience prior to the ELP

	Cohorts			
	ZCL4Comp		**ZCL4Exp**	
	n	%	n	%
Nature of the work experience (NOTE: more than 1 option could be selected)				
Community pharmacy	62	63.92	102	71.33
Hospital Pharmacy	24	24.74	29	20.28
Primary health care clinic	7	7.22	8	5.59
Manufacturing Industry	2	2.06	1	0.70
Veterinary Pharmacy	0	0.00	2	1.40
Wholesale and Distribution	2	2.06	1	0.70
Total number of responses	***97***		***143***	
Hours per week spent working in a pharmacy environment				
< 3hrs /week	16	23.19	33	31.73
3 to 10 hrs/week	20	28.99	43	41.35
11 to 20 hours /week	2	2.90	0	0.00
> 20 hours / week	20	28.99	25	24.04
Short periods in vacation time (< 4 wks/year)	11	15.94	3	2.88
Time spent on pharmacy work-related activities				
i) Stock Management				
Seldom	5	7.25	13	12.50
Occasionally	27	39.13	36	34.62
Sometimes	9	13.04	8	7.69
Often	11	15.94	31	29.81
Frequently	15	21.74	16	15.38
ii) Assist with dispensing by fetching stock & preparing items, or manufacturing & compounding				
Seldom	0	0.00	1	0.96
Occasionally	7	10.14	15	14.42
Sometimes	9	13.04	20	19.23
Often	21	30.43	24	23.08
Frequently	30	43.48	44	42.31
iii) Reading prescriptions and dispensing				
Seldom	6	8.70	12	11.54
Occasionally	9	13.04	19	18.27
Sometimes	6	8.70	9	8.65
Often	13	18.84	32	30.77
Frequently	33	47.83	32	30.77
iv) Provide patient with dispensed medication & patient counselling				
Seldom	6	8.70	11	10.58
Occasionally	10	14.49	27	25.96
Sometimes	5	7.25	13	12.50
Often	16	23.19	22	21.15
Frequently	30	43.48	31	29.81
iv) Phone prescriber for clarification of prescription				
Seldom	28	40.58	57	54.81
Occasionally	18	26.09	32	30.77
Sometimes	2	2.90	1	0.96
Often	13	18.84	12	11.54
Frequently	6	8.70	2	1.92
v) Recommend over the counter (OTC) products and provide patient counselling				
Seldom	5	7.25	8	7.69
Occasionally	14	20.29	24	23.08
Sometimes	5	7.25	10	9.62
Often	16	23.19	24	23.08
Frequently	27	39.13	38	36.54
Sample size	*69*		*104*	

The finding that 100% of the students had prior work experience was expected as NMMU BPharm students are expected to complete a minimum of 80 externship hours per academic year from BPharm2, as a course requirement for the discipline of Pharmacy Practice. The extent and nature of these hours however, were unknown, hence the need to collect the data.

5.7.1 Nature of the pharmacy work environment

Community pharmacy was identified by the majority of students from both cohorts as the primary setting for the pharmacy work experience (63.92% of responses from ZCL4Comp students and 71.33% of responses from ZCL4Exp students) (Table 5.28). Hospital pharmacy was also featured (24.74% from ZCL4Comp group, versus 20.28% from ZCL4Exp group), with less than 10% of sites reported in the primary health care setting.

In response to the request for the breakdown of hours spent working in a pharmacy-related environment, it was found that most students worked between 3 and 10 hours per week (28.99% for ZCL4Comp, and 41.35% for ZCL4Exp) (Table 5.28). Of concern was the finding that some students spent more than 20 hours per week working in a pharmacy related environment (28.99% of ZCL4Comp students and 24.04% of ZCL4Exp students). These students may be self-funding their academic studies or may not be registered for the full credit load of modules for the academic year.

5.7.2 Time spent on pharmacy-related work activities

Stock management

Students from both cohorts identified involvement in stock management activities, with 37.34% of ZCL4Comp students involved “often” or “frequently” and 45.19% of

ZCL4Exp students (Table 5.28). However, a greater percentage of students in both cohorts identified a reduced ("seldom" or "occasionally") involvement in stock management activities (46.38% of ZCL4Comp students and 47.12% of ZCL4Exp students) which may be a result of increased involvement of the senior students in dispensing and direct patient-focused activities.

Assist with dispensing (fetching stock, preparing, compounding or manufacturing items)

Initial exposure of pharmacy students to prescription reading and dispensing usually involves an assisting role, where the student assists the pharmacist in the dispensing process, usually in a "pick and pack" role. Most of the students in both cohorts identified good exposure to this activity, as indicated by the finding that 73.91% of the ZCL4Comp students and 65.39% of the ZCL4Exp students participated "often" or frequently" in this activity (Table 5.28).

Reading prescriptions and dispensing

One of the skills which cannot be taught in the university-based undergraduate pharmacy teaching environment is prescription reading, with associated interpretation of prescriber handwriting. This skill is developed by the activity of reading, interpreting and dispensing prescriptions, which are then checked by a pharmacist for correctness. Involvement in this activity was identified as occurring 'often" or "frequently" by 66.67% of the ZCL4Comp students and 61.54% of the ZCL4Exp students (Table 5.28). The result suggested that a third of the students had received reduced exposure to this activity, which is of concern at the level of a final year BPharm student.

Provide patient with dispensed medication and offer patient counselling

Many students in both cohorts (66.67% of ZCL4Comp and 50.96% of ZCL4Exp students) identified involvement in this activity on a "frequent" or "often" basis (Table

5.28). Worth noting was the relatively high percentage of ZCL4Exp students who participated in this activity on a "seldom" or "occasional" basis (36.54%, compared to 23.19% of the ZCL4Comp students).

Phone prescriber for clarification of prescription

There was a notable lack of student involvement involving interaction with the prescriber in both cohorts, as indicated by the majority of students identifying that they were involved in phoning the prescriber on a "seldom" or "occasional" basis, as reported by 66.67% of ZCL4Comp students and 85.58% of ZCL4Exp students (Table 5.28). Reasons for the lack of interaction were not identified.

Recommend OTC products and offer patient counselling

This activity included pharmacist-initiated therapy, which tends to be focused on recommendations on the choice of over-the-counter (OTC) medication and counselling the patient on appropriate use of the selected products. Many of the students in both cohorts identified good involvement in this activity on a "frequent" or "often" basis, as indicated by 62.32% of the ZCL4Comp group and 59.62% of the ZCL4Exp group (Table 5.28).

5.7.3 Summary

The questionnaire-based survey administered to students in both cohorts provided insight into pharmacy work experience obtained by NMMU pharmacy students prior to commencement of the ELP. Although all of the participating students had prior work experience in a pharmacy environment, much of the work had occurred in the community pharmacy setting. Student exposure to the more clinical and patient-focused activities such as patient counselling, pharmacist-initiated care using OTC products and inter-professional communication varied considerably between students. The majority of

students from both cohorts highlighted a lack of interaction with medical doctors or prescribers.

5.8 RETROSPECTIVE REVIEW OF PHARMACOLOGY2 AND PHARMACOLOGY3 SUMMATIVE ASSESSMENTS

A retrospective review was conducted on Pharmacology2 and Pharmacology3 summative written November assessments, in order to determine the progressive development and extent of assessments requiring higher order thinking and application of knowledge. Currently, there is no system utilised by academic staff in the Pharmacy Department at NMMU that evaluates the content of pharmacology assessment papers. The approach used for the review was described in Chapter Three (section 3.7.1.7), and was modified from an approach described by Kim et al. (2012), based on Bloom's taxonomy (Bloom, 1956). Each question from two Pharmacology2 summative assessment papers (from academic years 2012 and 2013), and two Pharmacology3 papers (from academic years 2013 and 2014) was categorised according to the cognitive domains described in Bloom's taxonomy and the total number of marks allocated per cognitive domain in each paper was then expressed as a percentage (Table 5.29). Two reviewers independently evaluated the papers and the average scores were then determined. The assessment papers selected were the Pharmacology2 and Pharmacology3 summative examination papers that would have been written by the participating students in the comparator and experimental cohorts.

In Pharmacology2, the percentage of marks allocated to the higher order cognitive domains (application, analysis, synthesis and evaluation) was found to be very similar between the successive academic years, contributing 16% of the paper in 2012 and 14.5% of the paper in 2013 (Table 5.29). The percentage of the paper that was focused on factual

knowledge was also found to be relatively consistent over the two year period (30.5% in 2012, and 26.5% in 2013). The majority of marks in both Pharmacology2 assessment papers were allocated to the categories of knowledge and comprehension (84% of the 2012 paper, and 85.5% of the 2013 paper).

Table 5.29
Review of Pharmacology summative assessment papers written by Phase One and Phase Two cohorts, showing mark allocation (%) per category of cognitive domain, based on Bloom's Taxonomy

Cohort of Students Assessed	Categories of Cognitive Domains (based on Bloom's Taxonomy)	Mark allocation (%) per cognitive domain category in Pharmacology summative assessment papers					
		2012 Pharmacology2			**2013 Pharmacology3**		
		Reviewer 1	Reviewer 2	Mean	Reviewer 1	Reviewer 2	Mean
Phase One cohort	Knowledge	32.0	29.0	30.5	24.5	25.5	25.0
	Comprehension	53.0	54.0	53.5	34.5	34.0	34.3
	Application	15.0	17.0	16.0	41.0	40.5	40.8
	Analysis	0.0	0.0	0.0	0.0	0.0	0.0
	Synthesis / evaluation	0.0	0.0	0.0	0.0	0.0	0.0
		2013 Pharmacology2			**2014 Pharmacology3**		
		Reviewer 1	Reviewer 2	Mean	Reviewer 1	Reviewer 2	Mean
Phase Two cohort	Knowledge	28.0	25.0	26.5	24.0	27.0	25.5
	Comprehension	58.0	60.0	59.0	44.5	42.5	43.5
	Application	14.0	15.0	14.5	30.5	29.5	30.0
	Analysis	0.0	0.0	0.0	1.0	1.0	1.0
	Synthesis / evaluation	0.0	0.0	0.0	0.0	0.0	0.0

In Pharmacology3, mark allocation to the higher order cognitive domains (application, analysis, synthesis and evaluation) was found to be 40.8% in the 2013 assessment paper and 31% in the 2014 assessment paper (Table 5.29). Marks were consistently allocated in the knowledge domain, and found to be 25% in 2013 assessment paper, and 25.5% in 2014 assessment paper. The majority of marks in both Pharmacology3 assessment papers were allocated to knowledge and comprehension (59.3% of the 2013 paper and 69% of the 2014 paper), although less questions in the Pharmacology3

summative papers were found to be allocated to the categories of knowledge and comprehension, in comparison to Pharmacology2 papers.

5.8.1 Summary

The Pharmacology2 and Pharmacology3 summative assessment papers written by students in the study sample provided evidence of questions that required application of knowledge, although the mark allocation to the questions requiring higher order thinking skills in the Pharmacology3 papers was found to vary over the two consecutive academic years, in that the Phase Two (ZCL4Exp) cohort were exposed to fewer questions requiring higher order thinking skills. There was also evidence to suggest that assessment papers had an increasing percentage of marks wasallocated to questions requiring application of knowledge and analysis, as students progressed from Pharmacology2 to Pharmacology3.

5.9 SUMMARY OF CHAPTER FIVE

The results of the quantitative data were presented in Chapter Five. The demographics of the study sample were initially described, in order to provide information on relevant characteristics of the participants, such as age, gender, the admission route into the BPharm programme, mother tongue and the use of language in various settings. Indicators of academic achievement, such as APS, the BPharm weighted average marks prior to BPharm4, the rate of academic progression through the BPharm programme and assessment marks from Pharmacology2, Pharmacology3 and Pharmacology4 were presented. The pre- and post ELP test scores were provided for English reading comprehension, Raven's SPM (as a measure of problem solving ability) and learning styles, using Kolb's LSI. Additional quantitative data included in Chapter Five were obtained from the pre-ELP questionnaire-based survey of the study sample, which provided an insight into the extent and nature of work experience in pharmacy

environments prior to the ELP. Lastly, the data obtained from the retrospective review of the summative Pharmacology2 and Pharmacology3 assessment papers was presented. The discussion and further interpretation of the results presented in Chapter Five will be presented in Chapter Six.

CHAPTER SIX: DISCUSSION OF RESULTS

6.1 INTRODUCTION

Chapters Four and Five presented the qualitative and quantitative results, respectively. In keeping with the mixed methods research design, the qualitative results will now be integrated with the quantitative results and discussed in Chapter Six. As stated in Chapter One, the central research question for this study was:-

What would be the effect of an intervention aimed at supporting undergraduate pharmacy students during clinical placements, on academic achievement in, and student attitudes towards, experiential learning programmes (ELP)?

Six research sub-questions were identified for further investigation in order to explore the research question further:-

- To what extent does academic achievement in Pharmacology, and in the BPharm programme, predict academic achievement in the ELP?
- To what extent does the Admission Points Score (APS), the BPharm admission route and the rate of academic progression through the BPharm programme, predict academic achievement in the ELP?
- How do factors such as the English reading comprehension, previous work based experience in a pharmacy environment, learning styles and problem solving ability, influence academic achievement in the ELP?
- Do the assessment methods used in summative pharmacology examination papers prepare pharmacy students for clinical case-based assessments, which require application of knowledge through problem solving and clinical decision making?

- What are the students' experiences of the ELP?
- To what extent could supplemental academic support influence academic achievement in the ELP?

The integration and discussion of the results from the qualitative and quantitative data will now be discussed in the context of each of the six research sub-questions.

6.2 RESEARCH SUB-QUESTION ONE

To what extent does academic achievement in the BPharm programme, and in Pharmacology, predict academic achievement in the ELP?

6.2.1 Academic achievement in the BPharm programme

The weighted average module mark per academic year was calculated for BPharm1, BPharm2, and BPharm3, as a general measure of academic achievement in the BPharm programme, prior to registration in Pharmacology4 in the final year of the BPharm programme. The BPharm weighted average mark used in the current research can be compared to the GPA utilised in many research studies conducted in USA.

The distribution of weighted average module marks in the BPharm1, BPharm2 and BPharm3 academic record was found to be similar between the two cohorts (Table 5.9) and provided evidence to demonstrate that participants in both cohorts possessed similar academic abilities. While small differences were observed in the mean weighted average for BPharm1 and BPharm3, with the ZCL4Exp cohort achieving a higher mean weighted average for the BPharm3 academic year, but a lower mean weighted average for BPharm. The differences detected were found to be of small practical significance (Table 5.10).

6.2.1.1 Can academic achievement in the BPharm programme predict academic achievement in the ELP?

A Pearson product-moment correlation coefficient (*r*) was computed to assess the relationship between academic achievement in the BPharm programme and academic achievement in the ELP (using the summative Pharmacology4 November examination mark) for the combined ZCL4Comp and ZCL4Exp groups. There was a significant, positive, weak correlation between BPharm1 and BPharm2 and the summative Pharmacology4 November examination mark (Pearson's correlation: BPharm1: $r = .223$, $n = 171$; $p = .003$; BPharm2: $r = .278$, $n = 170$, $p < .001$). A significant, positive, moderate correlation was observed between BPharm3 weighted average and academic achievement in the ELP (Pearson's correlation: $r = .354$, $n = 172$, $p < .001$) (Table 6.1).

On closer examination of the weighted average marks, the strongest predictor of academic achievement in the ELP was found to be the BPharm3 weighted average mark, which consistently showed a significant, positive, moderate correlation for ZCL4Comp, ZCL4Exp and the combined cohorts (Table 6.1).

When interpreting the data, it is important to note that the BPharm weighted average mark was calculated on successful completion of all modules in the relevant academic year and therefore may have included modules in which the summative examination or module was attempted more than once.

Table 6.1
Correlations between BPharm weighted average marks and Pharmacology marks and academic achievement in the ELP (measured by Pharmacology4 summative assessment mark)

	Cohorts								
	ZCL4Comp			ZCL4Exp			Combined		
	n	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*
BPharm1 weighted average	68	.220	.071	103	.193	.051	171	.223	.003
BPharm2 weighted average	67	.391	.001	103	.185	.061	170	.278	< .001
BPharm3 weighted average	69	.434	< .001	103	.357	< .001	172	.354	< .001
Pharmacology2 Nov exam	69	.286	.017	104	.276	.005	173	.280	< .001
Pharmacology3 Nov exam	69	.338	.005	104	.226	.022	173	.267	< .001

ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort; *n* = sample size; *r* = Pearson correlation coefficient; *p* = probability or *p* value

Although numerous studies have investigated GPA as a predictor, very few have investigated GPA as a predictor for academic success in the more clinical components of the pharmacy programmes. The first professional year (P1) GPA score in the PharmD degree programme was found to be a significant predictor (r = .501) for success in the summative Pharmacy Curriculum Outcomes Assessment examination, which is written by second professional year students (P2) on completion of the PharmD coursework covering the basic sciences and pharmaceutical sciences (Giuliano et al., 2016). However, the authors emphasised that by this stage of the PharmD programme, students had completed 75% of the patient care labs but only 25% of the therapeutics course modules. The observation complicates comparisons to the Pharmacology4 summative mark used in the current research, as the Pharmacology4 summative assessment is written on completion of the Applied Therapeutics module (Pharmacology4). Several studies have shown the

predictive value of pre-pharmacy GPA, specifically science (particularly chemistry) and mathematics on academic achievement in the pharmacy programmes, but in these studies, the focus was on predictors of academic success in the first year of pharmacy programmes (Chisholm et al., 1995; Crow et al., 2005; Houglum et al., 2005). Predictors of academic success in the externship phase of the professional pharmacy curriculum at St Louis College of Pharmacy (which is comparable to the ELP at NMMU), were found to be the pre-professional subjects of biology, organic chemistry and physiology (Crow et al., 2005). Kidd and Latif (2003) found that only CCTST was a predictor of student performance (p = .008) during the practice-based clerkships in the fourth professional year of the PharmD programme, although PCAT and GPA could be used as predictors for the overall pharmacy GPA in first, second and third year of the PharmD programme.

In summary, many studies in pharmacy education have utilised pharmacy GPA scores as indicators of academic performance (Allen & Bond, 2001; Chisholm, 2001; Chisholm et al., 1995; Crow et al., 2005; Kuncel et al., 2005; McCall et al., 2006; Renzi et al., 2007; Sansgiry et al., 2006). One criticism of the GPA as an indicator of performance is that it may not be as sensitive as the individual module scores (Unni et al., 2011). In addition, the use of GPA (or in the current research, the BPharm weighted average) as an indicator of academic achievement is not without limitations, considering that marks or grades, when viewed as measures of academic performance, may not always be associated with high intellectual ability or hard work. Academic success may be more closely linked to effective learning and cognitive strategies (Kleijn, van der Ploeg, & Topman, 1994), as well as socio-cognitive factors such as student motivation and self-efficacy (Carroll & Garavalia, 2004; M. Hall, Hanna, Hanna, & Hall, 2015).

6.2.2 Academic achievement in Pharmacology

The Pharmacology2, Pharmacology3 and Pharmacology4 November examination marks (summative assessments) were used as a measure of academic achievement in Pharmacology. The Pharmacology2 and Pharmacology3 marks reflect the first attempt, written November summative examination mark, in order to allow direct comparison with the Pharmacology4 first attempt, written summative November examination.

The two cohorts demonstrated a similar distribution of Pharmacology2 marks and Pharmacology3 marks (Table 5.13 and Table 5.15). No significant difference (p = .822) was observed in the mean Pharmacology2 mark between the ZCL4Comp group and the ZCL4Exp group (Student's *t*-test, *t*-value = 0.23, n = 173) (Table 5.14). Similarly, no significant difference (p = .619) was found in the mean Pharmacology3 mark between the ZCL4Comp group and the ZCL4Exp group (Student's *t*-test, *t*-value = -0.40, n = 173) (Table 5.16). The mean mark obtained in the combined Pharmacology2 group was 52.35±11.89% (Table 5.14) and 54.15±9.23% for the combined Pharmacology3 group (Table 5.16). Thus, students from the two cohorts demonstrated similar levels of academic achievement in Pharmacology2 and Pharmacology3.

6.2.2.1 Can academic achievement in Pharmacology2 and Pharmacology3 predict academic achievement in ELP?

The Pharmacology2 summative November examination marks showed a significant, positive, weak correlation with Pharmacology4 summative November examination marks in the ZCL4Comp (Pearson's correlation, r = .286, n = 69, p = .017) and ZCL4Exp (Pearson's correlation, r = 0.276, n = 104, p = .005) cohorts (Table 6.1).

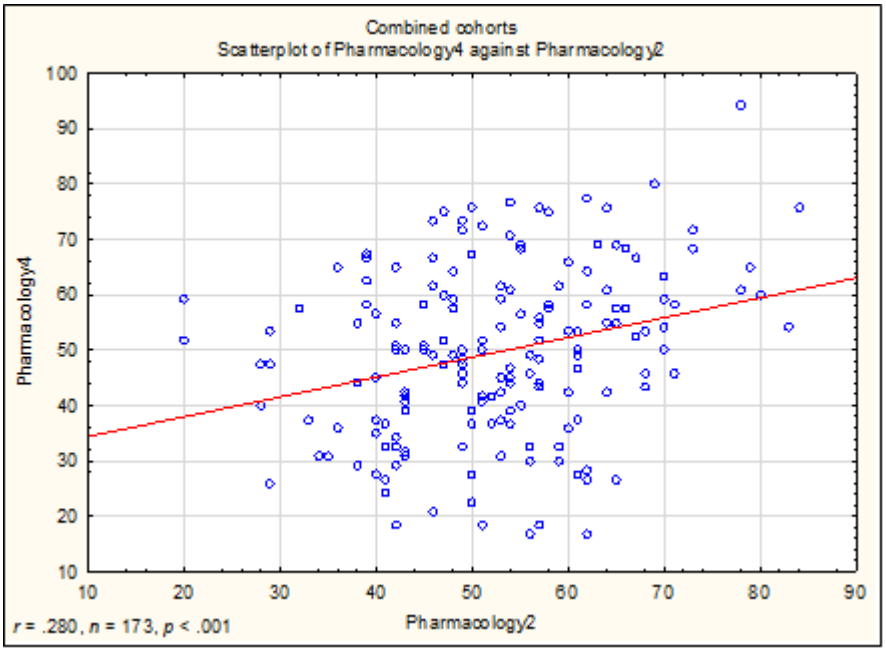


Figure 6.1

Correlation between Pharmacology4 summative November examination mark and Pharmacology2 summative November examination (combined cohorts) (Pearson correlation: r = .280, n = 173, p < .001)

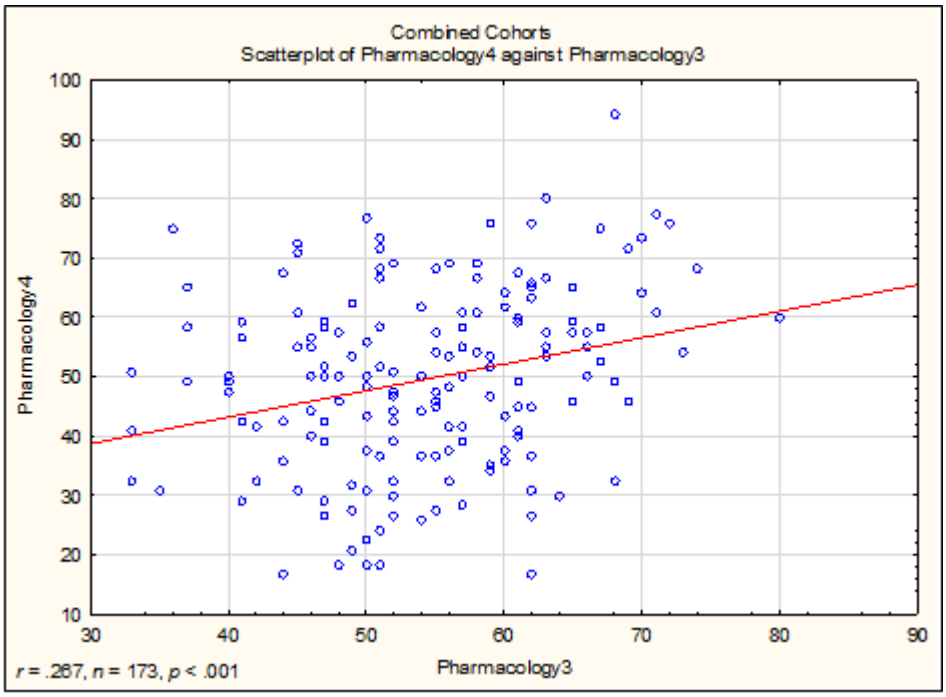


Figure 6.2

Correlation between Pharmacology4 summative November examination mark and Pharmacology3 summative November examination (combined cohorts) (Pearson correlation: r = .267, n = 173, p < .001)

This relationship strengthened with ZCL4Comp's Pharmacology3 November examination marks showing a significant, positive, moderate correlation with the Pharmacology4 November examination mark (Pearson's correlation, $r = .338$, $n = 69$, $p = .005$). However, ZCL4Exp demonstrated a significant, positive but weak correlation (Pearson's correlation, $r = 0.226$, $n = 104$, $p = .022$) (Table 6.1).

Overall, for the combined cohorts (Figure 6.1 and 6.2), a significant but weak correlation existed between Pharmacology2 and Pharmacology3 assessments and academic achievement in the ELP (Pearson correlation: Pharmacology2: $r = .280$, $n = 173$, $p < .001$; Pharmacology3: $r = .267$, $n = 173$, $p < .001$).

The lack of a strong association between the Pharmacology2 and Pharmacology3 summative assessment marks and academic achievement in the ELP may in part, be due to the different formats used in assessments. The structure of the Pharmacology2 and Pharmacology3 assessment papers is based on the traditional format of multiple choice questions and short answer responses, compared to the open book, clinical case study-based format used in the Pharmacology4 assessments. Building a strong foundation of factual knowledge in multiple topic areas cannot be overlooked in undergraduate pharmacology courses, as knowledge acquisition is essential for problem solving and evaluating patient cases in the clinical setting. Factual knowledge must be in place for effective application of knowledge to occur (Kim et al., 2012). For undergraduate students, the initial phase of knowledge acquisition may in some cases, be restricted to acquisition of factual information through "rote learning", which is used as a coping mechanism by students battling with academically demanding subjects like pharmacology, to the exclusion of comprehension and understanding, which are required for application of knowledge (Taylor et al., 2006).

In the context of the current research, the high incidence of ESL students in both cohorts may have played a role in the approach to learning pharmacology, as explained by the focus group participants.

> *At times, if I don't understand something I just memorise it (P5: 2015:Pre-ELP)*
> *If I study pharmacology, I study to understand, to see that it happening in my head but I know a lot of people in my class, they start three weeks before the time, and they start revising it word for word for word. How are you going to integrate that word for word, if you haven't studied it to understand it? (P2:2015:Pre-ELP)*

Attempts at NMMU to encourage application of knowledge during Pharmacology3 practical sessions and assessments have not always had the expected and desired outcome, with some focus group participants reporting a lack of integration of knowledge as a result of group dynamics.

> *In my group, everyone was just, okay, you do side-effects, you do mechanisms, we never got to sit down and discuss the problem ... everyone else would say, oh man, it's easy, you and I are going to work on side-effects, check the mechanism of action, and we are not relating the drugs or the case to each other (P1: 2013:Post-ELP)*

> *I definitely think that with the third year SOAPs [simulated clinical case scenarios], I suppose, in a way it helped that at least we had the format but then there was absolutely no integration (P2: 2014:Post-ELP)*

> *All this time it's just been [pharmacology] theory and very boring and difficult (P6: 2015: Pre-ELP)*

> *I think I learnt better with simulated pracs then actually just learning from my notes and then having to think of how I would apply this to a patient (P1: 2014: Pre-ELP)*

The results suggest that further research is warranted with respect to the students' approaches to learning pharmacology, in order to encourage deep rather than surface learning, which tends to be characterised by a superficial level of understanding, a lack of integration of knowledge, rote learning and "regurgitation" of course material through memorisation and an inability to apply knowledge (Tsingos et al., 2015).

The learning approaches of students cannot be viewed in isolation of the teaching and assessment strategies used by pharmacy academic staff. Thus, the content of the pharmacology assessment papers needed closer examination in order to determine the development of higher order cognitive skills. The retrospective review conducted on the summative pharmacology November examination assessment papers written by students from the two cohorts (Section 5.8) found that the ZCL4Comp group were exposed to a greater content of questions in the application and analysis categories as the Pharmacology3 paper written in November 2013 had the highest percentage of marks allocated to application and analysis of information (40.8%), compared to 31% in the Pharmacology3 November 2014 paper written by ZCL4Exp (Table 5.29). As shown in Table 6.1, ZCL4Comp were found to have Pharmacology3 summative marks which displayed a significant, positive, moderate correlation with the Pharmacology4 November examination marks (Pearson's correlation, $r = .338$, $n = 69$, $p = .005$). The preliminary finding suggests that earlier exposure to questions that incorporate application of knowledge in pharmacology may increase the level of preparation for the clinical case study-based Pharmacology4 post-ELP assessment, as shown for ZCL4Comp, but further investigation is warranted as the data only represented Pharmacology3 November summative examinations written by two cohorts of students over two consecutive academic years, and therefore cannot be considered as conclusive evidence.

6.2.2.2 Formative and summative Pharmacology4 marks in the comparator and experimental cohorts

Two sets of Pharmacology4 marks were considered for analysis, the first formative Pharmacology4 assessment mark obtained early in the fifteen week ELP (after 5 weeks) and the summative Pharmacology4 assessment mark, obtained on completion of the module. No significant difference (p = .095) was observed in the mean formative Pharmacology4 marks between the ZCL4Comp group (n = 69) and the ZCL4Exp group (n = 104) (Student's t-test, t-value = -1.68, n = 173) (Table 5.18). The difficulties experienced by students from both cohorts with the first clinical case study-based assessment paper were clearly demonstrated by the low mean Pharmacology4 formative assessment marks achieved by ZCL4Comp (29.71±22.58%, n = 69), and ZCL4Exp (35.05±18.90%, n = 104).

The quantitative data obtained from the Pharmacology4 assessment marks was strongly supported by the qualitative data obtained from focus groups and open-ended questions in the Pharmacology4 Module Feedback questionnaire. The clinical case study-based assessments were identified as one of the most difficult aspects of the ELP by 26.73% (n = 134) of the students from both cohorts, with focus group participants describing high levels of anxiety associated with the assessments:

> *I was very anxious ... the way I was perusing books and this paper, it was so abnormal. I don't know what happened but I couldn't even find Ativan®, and the books were all there - there was nothing that was not there (P6:2015:Pre-INT).*

> *I was also anxious, and I had problems identifying the problem in the case because I was very anxious. I was worrying about what I'm going to say in the answer before I could even identify the problem (P10: 2015:Pre-INT)*

I was also anxious. I couldn't keep myself calm so I could just recognise what was going on (P11:2015:Pre-ELP)

I would just like to add with the anxiety that it's definitely what you hear from last year's fourth years. I'd spoken to someone and they were like, don't expect good marks for the first test. And then when I went in there, because I also struggled with question one, because I couldn't identify what the problem was. But then as soon as I identified it, I felt so stupid, but it was all the anxiety - your brain literally just shrivels up and does that (P14:2015:Pre-INT)

Other participants described a feeling of helplessness and feeling completely unprepared for the reality of the first open book, case study based assessment.

Because it was our first open book, I didn't know what to do ... so I was a bit confused, I didn't know what to touch [resources] so I hope the second one [assessment] will go much better (P12:2015:Pre-INT)

It's like you've got no clue, whatever you doing, a different approach was needed and we didn't recognise that (P9:2015:Pre-INT)

Mixed feelings were expressed by participants regarding the value of the two lecture-based preparatory sessions on "how to write an open book test", which included a previous Pharmacology4 assessment paper for practice purposes, as well as the exposure to reviewing patient cases reviews through screening patient files and writing patient case reviews during the ELP.

Most difficult was the open book tests. We need more practice examples before going straight to the tests (P19:2014:Post-ELP)

Open books. You're unsure which way to go and sometimes this takes some marks down. For example must you lower the dose or must you stop the drug? (P21:2014:Post-ELP)

That Friday when you went through the past papers ... I thought, isn't this the same thing as the SOAP, but we were finding the problems, and creating our own problems and I was like, this is the same approach, so that was my approach (P7:2015:Pre-INT)

I would say these screenings really helped me a lot in the open book because ... a lot of things I could remember from my screenings, so Ativan, when I looked at that I knew immediately what it was and then some of the other drugs I'd screened and I remembered the drug interactions from the screening, and what not to combine it with, so I feel that really helped me a lot (P1:2015:Pre-INT)

I didn't really benefit much from the SOAPs [patient case reviews] in terms of connecting it now to the open book, because many times, when we did our SOAP, it was a matter of time and also marks, so sometimes we ended up dividing the work, so we give problem one to this one, and then problem two to that one and then we will meet on Saturday and we will put the SOAP together (P5:2013:Post-ELP)

However, the Pharmacology4 summative assessment marks showed a substantial and statistically significant ($p < .001$) improvement by the end of the ELP for both cohorts (Table 5.21). In addition, a significant difference ($p = .030$) was noted in the mean summative Pharmacology4 marks between the ZCL4Comp ($n = 69$) and ZCL4Exp groups ($n = 103$) (Student's *t*-test, *t*-value = -2.20, $n = 172$), with Cohen's *d* showing a small practical significance ($d = 0.34$) (Table 5.20). The difference between the mean summative Pharmacology 4 mark obtained by ZCL4Comp and ZCL4Exp was 5.13%, with the ZCL4Exp cohort obtaining the higher mean summative assessment mark (51.63±14.95%). This finding highlights a difference in the mean Pharmacology4 mark obtained by the ZCL4Comp cohort, who were not exposed to the intervention, and the ZCL4Exp cohort, who had participated in the intervention. The implication of this result will be discussed in Section 6.7, with the evaluation of the intervention.

6.2.3 Summary

Academic achievement in BPharm3 was found to be a significant moderator predictor of academic success ($p < .001$) in the ELP, compared to significant but weak correlations observed for BPharm1 ($p = .003$) and BPharm2 ($p < .001$), using data from the combined cohorts (ZCL4Comp and ZCL4Exp).

Academic achievement in the first two years of pharmacology was found to show significant ($p < .001$), positive, weak correlations (Pharmacology2: $r = .280$, Pharmacology3: $r = .267$), with academic achievement in the ELP, for the two combined cohorts. The switch from the traditional format of questions used in Pharmacology2 and Pharmacology3, to the open-book, clinical case study-based format of assessment used in Pharmacology4 may have contributed to the weak associations observed. However, of interest was the stronger association observed between ZCL4Comp's Pharmacology3 summative assessment mark and academic achievement in the ELP (ZCL4Comp:Pharmacology3: $r = .338$, $n = 69$, $p = 005$; ZCL4Exp: $r = .226$, $n = 104$, $p = .022$), as the ZCL4Comp cohort was exposed to Pharmacology2 and Pharmacology3 summative assessment papers that had a higher proportion of questions requiring higher cognitive thinking skills (i.e. application and analysis) (Table 5.29).

Thus the results presented provide evidence that research objective 1 was met, namely to compare the level of academic achievement in the ELP to academic achievement in the BPharm programme, and in Pharmacology.

6.3 RESEARCH SUB-QUESTION TWO

To what extent does the Admission Points Score (APS), the BPharm admission route and, the rate of academic progression through the BPharm programme, predict academic achievement in the ELP?

6.3.1 Admission Points Score (APS)

Admission into the BPharm degree programme offered by NMMU is guided by the APS (used by South African universities), which is similar to the PCAT utilised in USA. No significant difference (p = .874) was found in the distribution of APS scores between ZCL4Comp and ZCL4Exp cohorts (Chi^2: df = 4, n = 159 (Table 5.7). The mean APS scores were also similar between the cohorts (p = .767, Student's t-test: t = 0.30, n = 159) (Table 5.8). The predominance of high APS scores (Table 5.7) provided evidence that the majority of students in both cohorts appeared to be above average in academic ability, based on APS in the context of the setting of the research.

Computation of the Pearson product-moment correlation coefficient (r) was used to determine the association between the APS and the BPharm weighted average, for the combined cohorts (Table 6.2). Significant (p < .001), positive, moderate correlations were observed between APS and the BPharm1 weighted average (r = .328, n = 155), BPharm2 weighted average (r = .367, n = 156) and the BPharm3 weighted average (r = .331, n = 156). The finding supports the use of APS as a predictive indicator used in the pre-admission phase by NMMU, for screening prospective applicants to the BPharm programme.

The Pearson product-moment correlation coefficient (r) was also computed in order to determine the relationship between the APS and pharmacology summative

assessment marks. Again, a significant ($p < .001$), positive, weak correlation ($r = .236$, $n = 156$) was noted for Pharmacology3, while significant ($p < .001$), positive, moderate correlations were found for Pharmacology2 ($r = .317$, $n = 156$), and for Pharmacology4 ($r = .348$, $n = 158$).

Table 6.2
Correlations between APS and the BPharm weighted average and Pharmacology summative assessment marks for the comparator and experimental cohorts

Strength of relationship between APS and different variables	Cohorts								
	ZCL4Comp			ZCL4Exp			Combined		
	n	*r*	*p*	*n*	*r*	*p*	*n*	*r*	*p*
BPharm1 weighted average	59	.352	.006	96	.320	.001	155	.328	<.001
BPharm2 weighted average	58	.279	.034	96	.437	< .001	154	.367	<.001
BPharm3 weighted average	60	.338	.008	96	.335	.001	156	.331	<.001
Pharmacology2 Nov exam	60	.292	.024	96	.339	.001	156	.317	<.001
Pharmacology3 Nov exam	60	.183	.162	96	.283	.005	156	.236	<.001
Pharmacology4 Nov exam	60	.421	.001	95	.303	.003	155	.348	<.001

n = sample size; *r* = Pearson correlation coefficient; *p* = significance level
ZCL4Comp: comparator cohort: ZCL4Exp: experimental cohort

6.3.1.1 Can APS predict academic achievement in ELP?

A significant, positive, moderate correlation (Pearson's correlation, $r = .348$, $n = 158$, $p < .001$) was observed between the APS and Pharmacology4 summative November examination mark (used as a measure of academic achievement in the ELP) in the combined cohorts (ZCL4Comp and ZCL4Exp). This finding is in contrast to research by Kidd and Latif (2003) who reported PCAT (and GPA) as predictors for the overall pharmacy GPA in first, second and third year of the PharmD programme, but the PCAT was not found to be a predictor of student performance in the fourth, practice-based

clerkship year of the PharmD programme, which is comparable to the ELP at NMMU. The composite PCAT score was also found to significantly ($p < .001$) and positively correlate with the North American Licensure Examination (NAPLEX) (McCall, MacLaughlin, Fike, & Ruiz, 2007), which was revised in 1986 to a scenario-based format using patient-centred questions, rather than the former subject-centred questions. The PCAT is used extensively in USA as a predictive indicator for admission to pharmacy degree programmes, and a meta-analysis of the validity of PCAT confirmed the PCAT's validity as a moderate predictor of second and third year GPA's, while the Maths Reasoning Score on the PCAT achieved an operational validity of 0.51 with first year GPA (Kuncel et al., 2005).

It is worth noting that the APS for admission to the BPharm degree programme at NMMU is 38, with a NSC achievement rating of at least 5 (60 to 69%) for Mathematics and Physical Science (NMMU, 2012). Several studies have shown the predictive value of pre-pharmacy GPA, specifically science (particularly chemistry) and mathematics on academic achievement in the pharmacy programmes (Chisholm et al., 1995; Crow et al., 2005; Houglum et al., 2005). The subject-specific requirements of Physical Science and Mathematics for the BPharm degree programme at NMMU may have contributed to the predictive power of the APS when determining academic achievement in the general BPharm programme. The logical reasoning inherent in Mathematics may also have contributed to APS's predictive association with academic achievement in the ELP, which requires extensive problem solving and clinical reasoning skills, using logical, analytical reasoning processes.

6.3.2 BPharm Admission Route

The majority (86.13%) of participating students from the comparator and experimental cohorts were registered for the four year BPharm programme, with no significant difference (p = .248) observed between the ZCL4Comp and ZCL4Exp cohorts in the distribution of students registered for the 4 year BPharm and 5 year Extended BPharm programme (Chi^2, df = 1, n = 173) (Table 5.1).

6.3.2.1 Can the BPharm admission route predict academic achievement in ELP?

No significant difference (p = .409) was observed in the mean Pharmacology4 summative assessment mark obtained by students from both cohorts, when the BPharm admission route was considered (Student's t-test, t-value = 0.83, n = 172) (Table 6.3).

Table 6.3
Four year BPharm degree and 5 year Extended BPharm degree: Comparisons of the mean Pharmacology4 summative assessment marks

Pharmacology4 summative assessment mark	Cohorts					
	ZCL4Comp		ZCL4Exp		ZCL4Comp & ZCL4Exp	
	4 year BPharm	5 year BPharm	4 year BPharm	5 year BPharm	4 year BPharm	5 year BPharm
n	62	7	86	17	148	24
Mean	47.20	40.24	51.95	50.05	49.96	47.19
Standard Deviation	15.19	14.58	15.00	15.00	15.21	15.26

ZCL4Comp: 4 year BPharm vs 5 year BPharm: Student's t-test: t-value =1.15, p = .253, n = 69.
ZCL4Exp: 4 year BPharm vs 5 year BPharm: Student's t-test: t-value = 0.48, p = .635, n = 103.
Combined ZCL4Comp & ZCL4Exp: 4 year BPharm vs 5 year BPharm: Student's t-test: t-value = 0.83, p = .409, n = 172
ZCL4Comp: comparator group; ZCL4Exp: experimental group.

The finding suggests that the admission route into the BPharm programme did not impact on academic achievement in the ELP.

6.3.3 Academic Progression

The rate of academic progression through the BPharm programme was determined using the BPharm registration code and the year of first registration as a BPharm student, in order to calculate the number of years taken to progress to BPharm4 (Section 5.4.3). Only 59.30% of students in both cohorts (n = 172) reached the final year of the BPharm programme within the minimum period of time (within three years for the four year BPharm programme, and within four years for the five year Extended BPharm programme) (Table 5.11).

Academic difficulties are estimated to be experienced by six to 15% of health professions students in USA (Maize et al., 2010). In South Africa, additional difficulties are often experienced by working class students from diverse cultural backgrounds, who struggle with issues related to language, inadequate educational culture and preparation prior to entering university, finances and other socioeconomic issues (McMillan, 2007).

While recognition of the many external factors which impact on academic progression is important, the rigour and intensity of the pharmacy curriculum must also be considered. Sansgiry, Kawatkar, Dutta, and Bhosle (2004) provided evidence to suggest that academic progression was not positively associated with improved time management, study strategies, academic and test competency and academic performance in pharmacy students. When viewed in the context of NMMU's BPharm programme, Sangiry's findings suggest that supplementary academic support may still be justified after the first year of the BPharm programme, as the pharmacy curriculum is typically complex in content, and academic progression may not necessarily be associated with improved academic skills. In addition, NMMU's admissions policy is aimed at promoting access to the higher education system in order to address past inequalities in education, and

consequently, at-risk students may be allowed to continue with BPharm studies. Students with suboptimal academic performance and slower than recommended rates of academic progression are not automatically excluded but may be allowed to continue on the proviso that the relevant modules are passed within a specified time period. The consequence is that progression to the final year of the BPharm programme does not necessarily imply improved academic performance but may rather be viewed as academic persistence on behalf of the student.

6.3.3.1 Can the rate of academic progression through the BPharm programme predict academic achievement in the ELP?

A practically significant difference (p = .025, Cohen's d = 0.56) was observed in the mean Pharmacology4 summative assessment mark in the ZCL4Comp group when students progressing at the normal rate, reaching BPharm4 within the minimum time period, were compared to students with a slower rate of academic progression (Student's t-test, t-value = 2.29, n = 69) (Table 6.4).

Table 6.4
The rate of academic progression and the mean Pharmacology4 summative assessment mark in the comparator and experimental cohorts

Pharmacology4 summative November examination mark (%)	Cohorts			
	ZCL4Comp (n = 69)		ZCL4Exp (n = 102)	
	Within the minimum period	Exceeded the minimum period	Within the minimum period	Exceeded the minimum period
n	39	30	63	39
Mean	50.06	41.86	52.06	51.00
Standard deviation	13.90	15.73	15.48	14.41

Note: 4 year BPharm programme: minimum period = 3 years; 5 year Extended BPharm programme: minimum period = 4 years.
Student's t-test: **ZCL4Comp**: t-value = 2.29, n = 69, p = .025, Cohen's d = 0.56; **ZCL4Exp**: t-value =0.34, n = 102, p = .731
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort.

In contrast, the ZCL4Exp cohort obtained similar mean Pharmacology4 summative assessment marks, with no significant difference (p = .731) noted between students progressing at the slower and normal rates (Student's t-test, t-value = 0.34, n = 102) (Table 6.4). This finding was of particular interest due to the fact that the ZCL4Exp group were exposed to the intervention.

Significant differences were also observed in the mean Pharmacology4 summative assessment marks when the rate of academic progression was categorised into: minimum time period; one additional year; two additional years; and three or more additional years (ANOVA, F = 3.62, p = .014) (Table 6.5).

Table 6.5
Comparison of the mean Pharmacology4 summative assessment marks according to the rate of academic progression (combined cohorts)

Rate of academic progression through the BPharm programme (years)	**Mean Pharmacology4 Summative assessment mark**		
	Combined ZCL4Comp and ZCL4Exp		
	Mean	Standard Deviation	n
Minimum period	51.30	14.86	102
1 additional year	47.56	15.08	52
2 additional years	51.67	15.41	12
≥ 3 additional years	30.33	12.37	5
Sample size			171

ANOVA: F = 3.63, p = .014
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort

Post hoc analyses using Tukey's HSD indicated that the mean Pharmacology4 assessment mark for the group of students progressing at the slowest rate (≥ 3 years over the minimum period) was significantly lower (p = .036) than students progressing at a rate of 2 years over the minimum period (n = 12, Cohen's d = 1.46) and within the minimum period (p = .012, Cohen's d = 1.42). No statistically significant difference was observed in the mean Pharmacology4 summative assessment mark obtained by students progressing

at a rate of 1 year over the minimum period (p = .065) when compared to the students progressing at the slowest rate.

The results, therefore, suggest that the rate of academic progression may influence academic achievement in the ELP, with the academically weaker students progressing at a rate of 3 or more years over the minimum time period, achieving lower mean Pharmacology4 summative assessment marks. However, a strong association between the rate of academic progression and academic achievement in the ELP was not evident.

6.3.4 Summary

Section 6.3 presented the results and discussion pertaining to research objective 2, which investigated the APS, the admission route into the BPharm programme and the subsequent rate of academic progression.

The APS was identified as a predictor for academic achievement in the ELP, with a significant, positive, moderate correlation observed between the APS and Pharmacology4 summative November examination mark (Pearson's correlation, r = .348, n =158, p < .001).

The admission route into the BPharm programme did not predict academic achievement in the ELP, with no significant difference (p = .409) observed in the mean Pharmacology4 summative assessment marks obtained by students in the four year BPharm programme, compared to students in the five year Extended BPharm programme (Student's t-test, t-value = 0.83, n = 172).

The rate of academic progression was found to influence academic achievement in the ELP, with significant differences were observed in the mean Pharmacology4

summative assessment marks when the rate of academic progression was categorised into: minimum time period; one additional year; two additional years; and three or more additional years (ANOVA, $F = 3.62$, $p = .014$).

In summary, the findings have presented evidence that research objective 2 was met, namely, to what extent does the Admission Points Score (APS), the BPharm admission route and, the rate of academic progression through the BPharm programme, predict academic achievement in the ELP?

6.4 RESEARCH SUB QUESTION THREE

How do factors such as English reading comprehension, problem solving ability, learning styles, and previous work based experience in a pharmacy environment influence academic achievement in the ELP?

6.4.1 English Reading Comprehension and academic achievement in the ELP.

The computer-based English Reading Comprehension test was completed pre- and post-ELP by students in both cohorts (ZCL4Comp and ZCL4Exp). Test scores (/100) were used as an indicator of English reading comprehension ability. The scores were further categorised into four levels of ability (developing, expanding, functional, proficient) (Section 3.7.1.2). Ideally, students registered for Pharmacology4 should fall into the *proficient* category, in order to understand the relatively complex pharmacotherapeutic and medical literature.

6.4.1.1 Pre-ELP English Reading Comprehension Scores and academic achievement in the ELP

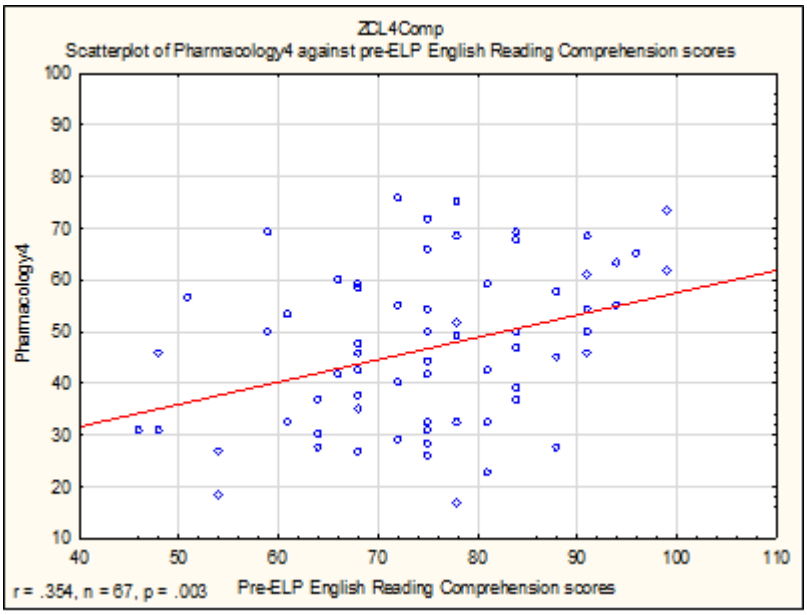


Figure 6.3

Correlation between Pharmacology4 summative assessment marks and the pre-ELP English Comprehension Reading scores (comparator cohort) (Pearson correlation: r =.354, n = 67, p = .003)

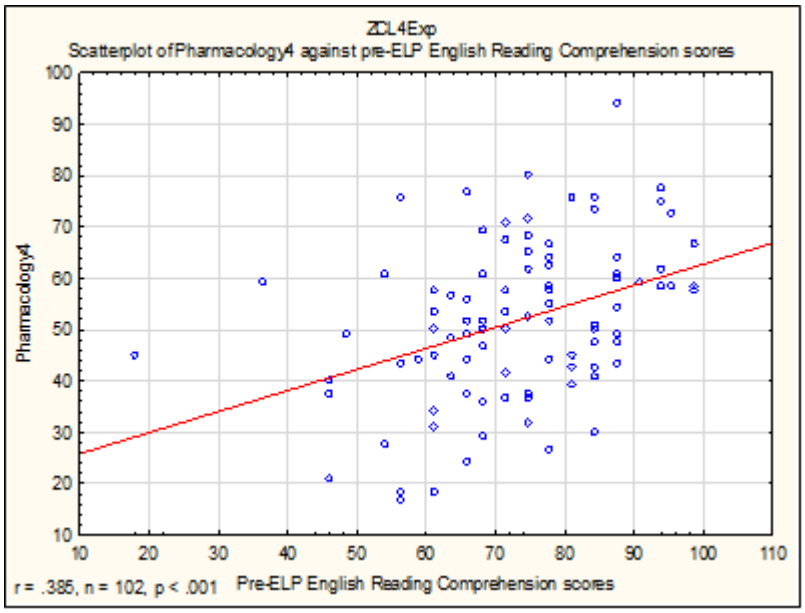


Figure 6.4

Correlation between Pharmacology4 summative assessment marks and the pre-ELP English Comprehension Reading scores (experimental cohort) (Pearson correlation: r = .385, n = 102, p < .001)

A significant, positive, moderate correlation was found between the pre-ELP English Reading Comprehension scores and academic achievement in the ELP (indicated by the Pharmacology4 summative examination mark) in both the ZCL4Comp and ZCL4Exp groups respectively (Pearson correlation: r =.354, n = 67, p = .003 and r = .385, n = 102, $p < .001$ respectively) (Figure 6.3 and 6.4).

Previous research conducted at NMMU by Boschmans and Webb (2014) found that pharmacy students with a Pharmacology2 summative examination mark ≥ 50% received significantly higher scores (p = .031, r = .299) for a general health vocabulary test, than students with scores below 50%. Vocabulary knowledge was utilised as a recognised indicator of reading comprehension ability (Zhang & Anual, 2008). The current research, therefore, supports this finding, providing evidence to show that as English reading comprehension scores increased, the summative Pharmacology4 assessment marks (i.e. academic achievement in the ELP) increased.

Reading is well-recognised as one of the most important academic activities (Nel et al., 2004) and at the tertiary level of education, students cannot merely identify words but must understand what they read, as a lack of comprehension has been shown to lead to poor academic performance (Bharuthram, 2012; Green, 2015; Hassell et al., 2007). In the USA, nearly 30% of college first year students require remediation in reading and writing (and arithmetic) (Maize et al., 2010). Poor reading skills can result in misunderstanding of examination questions, as well as heightened levels of text anxiety when confronted with unfamiliar words (Diaz-Gilbert, 2004). Several focus group participants expressed feelings of anxiety during the open book, clinical case study based assessments.

I was also anxious. I couldn't keep myself calm so I could just recognise what was going on (P11:2015:Pre-Int)

The finding of a significant and positive association between English reading comprehension skills and academic achievement in the ELP is also in line with international published research. The PCAT reading sub-score, which can be aligned to the English reading comprehension score used in the current research, was found to be a significant (p = .011) predictor of success in the Pharmacy Curriculum Outcomes Assessment examination (PCOA), written by second professional year PharmD students, while students who "did not prefer reading" achieved lower PCOA scores (Giuliano et al., 2016). The PCOA examination covers topics such as the basic biomedical sciences, pharmaceutical sciences, social, behavioural and administrative pharmacy services and clinical services and has been written by US PharmD students since 2009. Evidence of the importance of reading comprehension skills on academic success in pharmacology was also reported during a meta-analysis of the validity of the PCAT, which identified a high operational validity for PCAT-reading scores (based on sample-size weighted-mean observed correlations, n = 244, k = 3, ρ = .40) in relation to performance in Pharmacology scores in the NAPLEX examination (Kuncel et al., 2005).

6.4.1.2 Categories of English Reading Comprehension scores and academic achievement in the ELP

Only 19.53% of students in the two cohorts (n = 169) achieved a pre-ELP score in the category of *proficient*, while the majority of students were categorised as *functional* (58.58%) (Table 5.6). Significant differences (p < .001) were observed in the mean Pharmacology4 summative assessment marks obtained by students from the combined two cohorts, when grouped according to the four categories of English reading comprehension ability, using the pre-ELP English Reading Comprehension test scores (pre-ELP:

ANOVA, $F = 9.28$, $n = 164$) (Table 6.6). Post-hoc analyses using Tukey's HSD indicated that the mean Pharmacology4 summative assessment mark was statistically significantly higher in the *proficient (*59.17±12.17%, $p < .001$) and *functional* (49.74±14.82%, $p = .007$) categories, when compared to the *expanding* category (40.51±15.06%). The mean Pharmacology4 assessment mark was also found to be statistically significantly higher in the *proficient (*59.17±12.17%, $p = .007$) category, when compared to the *functional* category (49.74±14.82%).

Table 6.6
Comparison of the Pharmacology4 summative assessment mark, between the categories of English reading comprehension ability, based on test scores obtained pre- and post-ELP

Pre-ELP Categories of English Reading Comprehension	Combined Cohorts (ZCL4Comp & ZCL4Exp) Pharmacology4 summative assessment marks			**Post-ELP** Categories of English Reading Comprehension	Combined Cohorts (ZCL4Comp & ZCL4Exp) Pharmacology4 summative assessment marks		
	n	Mean	Standard Deviation		n	Mean	Standard Deviation
Proficient	32	59.17	12.17	Proficient	32	57.08	13.15
Functional	96	49.74	14.82	Functional	86	49.03	14.97
Expanding	34	40.51	15.06	Expanding	38	47.17	16.15
Developing	2	52.08	10.02	Developing	7	39.88	11.95
Total	164	49.70	15.43	Total	163	49.79	15.24
Pre-ELP: ANOVA, $F = 9.28$, $p < .001$				**Post-ELP**: ANOVA, $F = 4.099$, $p = .008$			

Closer examination of the categories obtained using the pre-ELP English Reading Comprehension test scores identified that the mean Pharmacology4 assessment mark in the lowest category of *developing* (52.08±10.01%) was actually higher than the mean Pharmacology4 assessment mark for the *expanding* category (40.51±15.06%). This finding was unexpected and required closer examination since a definite positive association had been found between the English Reading Comprehension test scores and academic achievement in the ELP. On further investigation, it was noted that two students, one from each cohort, scored below 30 in the pre-ELP testing session (Section 5.3.1). A

score below 30 is an abnormally low score for a final year BPharm student, so the two scores were assumed to be outliers, possibly as a result of test apathy, but the two scores were not excluded from the results.

With this in mind, a second round of analysis was performed, using the post-ELP English reading comprehension scores. Significant differences (p = .008) were again observed in the mean Pharmacology4 summative assessment marks obtained by students from both cohorts, when grouped in the four categories of English reading comprehension ability (post-ELP: ANOVA, F = 4.10, n = 163) (Table 6.6). Post hoc analysis using Tukey's HSD identified that the mean Pharmacology4 summative assessment mark in the *proficient* category (57.08±13.15%) was statistically significantly higher than the *developing* (39.88±11.95%, p = .028), the *expanding* (47.17±16.15%, p = .030) and the *functional* (49.03±14.97%, p = .040) categories. In addition, the mean Pharmacology4 assessment mark in the *developing* category (39.88%±11.95) was now lower (as would be expected) than the mean assessment mark for the *expanding* category (47.17±16.15%)(Table 6.6).

The results presented, therefore, confirmed a definite positive association between English reading comprehension ability and academic achievement in the ELP, and suggest that remedial interventions may need to be considered in order to improve reading comprehension in the context of pharmacy education at NMMU. Further insight into the findings necessitated closer investigation of the potential influence of mother tongue language on academic achievement in Pharmacology4.

6.4.1.3 Influence of Mother Tongue on pre- ELP Reading Comprehension Scores and academic achievement in the ELP

Two thirds of the participants in the research were ESL students (62.21%; *n* = 172) (Table 5.2). The percentage of ESL students was significantly higher (p = .004) in the ZCL4Exp group (70.87%, *n* = 103), compared to the ZCL4Comp (49.28%, *n* = 69) (Chi^2 = 8.20, *df* = 1, Cramer's *V*, 0.22) with Cramer's *V* showing a small practical significance (Table 5.2).

On closer examination of the influence of mother tongue, the following observations were noted. As would be expected, EFL students from both cohorts (*n* = 163) obtained significantly higher (p = .004) mean English reading comprehension scores (77.92±12.15) compared to ESL students (71.57±13.92), although this was of small practical significance (Student's *t*-test, *t*-value = -2.95, Cohen's *d* = 0.48, *n* = 163) (Table 6.7).

Table 6.7
Influence of mother tongue on pre-ELP mean English reading comprehension scores in comparator and experimental cohorts

Pre-ELP English reading comprehension scores	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	EFL	ESL	EFL	ESL	EFL	ESL
n	34	33	27	69	61	102
Mean	77.32	72.42	78.68	71.17	77.92	71.57
Standard deviation	12.36	12.44	12.07	14.62	12.15	13.92

Student's *t*-test: **ZCL4Comp**: *t-value* = -1.62, *n* = 67, *p* = .111.
ZCL4Exp: *t*-value = -2.37, n = 96, *p* = .020, Cohen's *d* = 0.54;
ZCL4Combined: *t*-value = -2.95, n = 163, *p* = .004, Cohen's *d* = 0.48
EFL: English first language; ESL: English second language; ZCL4Comp: comparator group: ZCL4Exp: experimental group: ZCL4Combined: both cohorts

Of interest was the finding that the ZCL4Exp group also demonstrated a practically significant difference (p = .020) between the mean English reading comprehension scores obtained by EFL students, compared to ESL students (Student's *t*-test: *t*-value = -2.37, n = 96, Cohen's *d* = 0.54), with the mean score obtained by the ESL group found to be 7.51%

lower. This finding may be linked to the significantly higher (p = .004) percentage of ESL students in the ZCL4Exp group (Table 5.2). English reading comprehension scores were found to be similar between the EFL and ESL students in the ZCL4Comp group.

When the influence of mother tongue on academic achievement in the ELP was considered, no significant difference (p = .430) was observed in the mean Pharmacology4 November assessment marks between EFL and ESL students in the combined cohorts (Student's *t*-test, *t*-value = -0.79, n = 171) (Table 6.8).

Table 6.8
Influence of mother tongue on academic achievement in ELP in comparator and experimental cohorts

Academic achievement in ELP (summative Pharmacology4 November exam marks)	Cohorts					
	ZCL4Comp		ZCL4Exp		Combined	
	EFL	ESL	EFL	ESL	EFL	ESL
n	34	33	27	69	65	106
Mean	46.83	46.15	55.33	50.13	50.76	48.85
Standard deviation	16.54	13.87	14.62	15.01	16.14	14.71

Student's *t*-test, EFL vs ESL:
ZCL4Comp: *t*-value = -1.62, n = 69, p = .854. **ZCL4Exp**: *t*-value = -1.61, n = 102, p = .111
ZCL4Combined: *t*-value = -0.79, n = 171, p = .430
EFL: English first language; ESL: English second language; ZCL4Comp: comparator group: ZCL4Exp: experimental group: ZCL4Combined: both cohorts

The results showed that the English Reading Comprehension scores in the ZCL4Exp and combined cohorts were influenced by mother tongue (Table 6.7). However, mother tongue did not appear to impact on academic achievement in the ELP, as the mean Pharmacology4 summative assessment marks were found to be similar between EFL and ESL students (Table 6.8). Thus mother tongue alone was not found to be a useful predictor of academic achievement. One possible reason for the lack of association between mother tongue and academic achievement may be due to the development of English language skills during the primary and secondary education settings, and in social settings, as well

as the multilingual background of many of the participants. The results demonstrate that the English Reading Comprehension scores provided a more accurate indication of English language skills in the context of the current research.

6.4.1.4 Summary

Both cohorts demonstrated a significant positive relationship between the pre-ELP English reading comprehension scores and academic achievement in the ELP, as measured by the summative Pharmacology4 examination marks (ZCL4Comp: Pearson correlation: $r = .354$, $p = .003$ and ZCL4Exp: $r = .385$, $p < .001$). The English reading comprehension ability was therefore identified as a predictor of academic success in the ELP.

Although EFL students from both cohorts ($n = 163$) obtained significantly higher ($p = .004$) mean English reading comprehension scores (77.92±12.15) compared to ESL students (71.57±13.92), no significant difference ($p = .430$) was found in academic achievement in the ELP, when Pharmacology4 assessment marks were compared for the EFL and ESL students in the combined cohorts (Student's *t*-test, *t* value = -0.79, n = 171). Thus mother tongue was not found to be a predictor of academic achievement in the ELP.

The results presented therefore provide evidence that research objective 3 was met, namely to determine the extent to which English reading comprehension ability influences academic achievement in the ELP.

6.4.2 Problem solving ability and academic achievement in the ELP.

In order to determine problem solving ability and identify any change in problem solving that may have occurred over the duration of the ELP, a closer look was required at changes in pre- and post-ELP Raven's SPM scores. The supplementary academic support sessions for ZCL4Exp were introduced as an intervention during the ELP. One

aspect of the intervention was to encourage the development of critical thinking and problem solving skills through scenario-based learning using real patient cases, and the active engagement of students in problem solving during the support sessions. Thus Raven's SPM test scores were also used to determine if the intervention influenced problem solving ability in ZCL4Exp group.

6.4.2.1 Problem solving ability (as measured by Raven's SPM scores), pre and post-ELP

No significant difference (p = .089) was observed in the pre-ELP mean total Raven's SPM test scores (/60) between ZCL4Comp and ZCL4Exp groups (Student's *t*-test: *t*-test, *t*-value = -1.71, n = 175) (Table 5.22), so the comparator and experimental cohorts were evenly matched prior to the ELP.

No significant change was noted between the mean pre-ELP and post-ELP Raven's SPM scores within the ZCL4Exp group (paired *t*-test: *t* value = 0.58, n = 81, p = .566) (Table 5.22). This finding suggests that the intervention did not influence problem solving ability in the experimental cohort, and that problem solving ability did not change over the time period of the research. One possible explanation for the lack of differentiation in test score changes could be that the items in Raven's SPM were not sufficiently challenging for university students and Raven's APM may have been more appropriate, as reported previously by Rushton and Skuy (2001). A known limitation of Raven's SPM is that the ability to differentiate between adults with high scores is restricted, and this limitation led to the subsequent development of Raven's APM (Raven et al., 2000). However, for the purposes of this research, Raven's SPM was selected in an attempt to measure problem solving ability. In addition, Raven's SPM had previously been administered to a pharmacy student population at NMMU, which then allowed comparisons of test scores to be made.

An unexpected finding was that the mean pre- and post-ELP Raven's SPM total scores in the ZCL4Comp group showed a practically significant difference (paired *t*-test: *t* value = -4.88, $n = 68$, $p < .001$, Cohen's $d = 0.59$) (Table 5.22). The ZCL4Comp cohort was not exposed to the intervention, so the overall gains in the mean total test scores observed were not expected. Two possible explanations exist. One is that problem solving skills in the ZCL4Comp improved during the ELP. However, no significant difference ($p = .538$) was observed in the post-ELP mean total test scores (/60) between the two cohorts (Student's *t*-test, *t*-value = 0.62, $n = 152$) (Table 5.22), so a measurable improvement in problem solving ability seems unlikely. An alternative explanation could be test apathy for the pre-ELP session, which was conducted on a Friday afternoon, after an academically loaded week. This may have resulted in lower pre-ELP scores, since the students were aware that the Raven's test scores would not contribute to the academic record and that participation in the testing sessions was voluntary. The mean pre-ELP test score for ZCL4Comp was lower than ZCL4Exp (49.28±4.95, $n = 69$ versus 50.61±5.13, $n = 106$ respectively), but not significantly different ($p = .089$, Student's *t*-test, *t*-value = -1.71, $n = 175$).

Previous research utilising Raven's SPM test scores in BPharm students was conducted in 2011 at NMMU (Boschmans, 2013). The mean total Raven's SPM score (/60) reported for the 2011 group of Pharmacology4 students ($n = 40$) was 49.03±5.11, which compared favourably to scores obtained in the current research (pre-ELP mean test score of 49.28±4.95 for ZCL4Comp and 50.61±5.13 for the ZCL4Exp). When the distribution across the grade categories between the two groups was considered, Boschmans (2013) reported that 50.00% of Ravens' SPM total scores (/60) in the Pharmacology4 cohort ($n = 40$) were categorised as Grade III (scores >49 but <57), with only 2.50% in Grade II (score ≥ 57 but ≤ 59) and no scores in Grade I (score ≤59). Lower

scores (in Grades IV and V) were obtained by 47.50% of the cohort. In the current research, pre-ELP scores in both cohorts showed a greater percentage of students achieving higher scores (ZCL4Comp (*n* = 69): Grade III = 60.87%, Grade II 4.35%, Grade I = 0%; ZCL4Exp (*n* = 106): Grade III = 62.26%, Grade II = 8.49%; Grade I = 1.89%). Lower scores (Grades IV and V) were achieved by 34.78% of ZCL4Comp and 27.36% of ZCL4Exp.

In terms of academic ability, the ZCL4Comp group were found to have a mean age of 25.33 years, so the pre-ELP mean Raven's SPM test scores (49.28±4.95) placed the ZCL4Comp cohort of students (*n* = 69) on the 25th percentile, based on a Raven's SPM score of 49 for 25th percentile and 54 for the 50th percentile, categorised for age (Raven et al., 2000, p. SPM81). Similarly, for ZCL4Exp, with a mean age of 23.66 years, the pre-ELP mean Raven's SPM total test score (50.61±5.13) placed the cohort of students (*n* = 69) just above the 25th percentile for Raven's SPM.

The finding suggests that students from both cohorts demonstrated average intelligence, based on the norms established for the UK (Raven et al., 2000), as the majority of students in the study sample were categorised as Grade III (intellectually average) according to Raven's SPM. This result conflicted with the APS test scores obtained on admission to BPharm1, where the APS results indicated that the study sample demonstrated an above average academic ability, based on subject grades achieved in the exit-level NSC Grade 12 examinations written in the final year of high school (secondary level of education). The apparent conflict in findings with respect to academic ability may in part be due to the cultural diversity of the study sample impacting on the performance of Raven's SPM. Researchers have reported lower Raven's scores in sub-Saharan Africans (Rushton & Skuy, 2001; Rushton et al., 2002; Wicherts et al., 2010), with

suggestions offered that the Flynn effect has not been encountered in sub-Saharan populations (Wicherts et al., 2010). However, a recent meta-analysis of Raven's Progressive Matrices, which considered age groups as well as developing versus developed countries, concluded that over several decades, the gain in scores have been robust and particularly evident in developing countries, especially for SPM, with definite evidence of the Flynn effect (Wongupparaj et al., 2015).

Another issue of greater concern that cannot be ignored is the validity and quality of South Africa's school leaving certificate, the NSC, on which the APS is based. Prior to release of the NSC results, Umalusi (the statutory body which sets and monitors standards for general and further education and training in South Africa) performs a standardisation process, which serves to correct problems by making adjustments to the results obtained. The problems encountered may relate to the quality of the examination papers, or may be driven by politically motivated needs for positive educational outcomes. Unfortunately, the standardisation often masks the actual academic achievements of the candidates, which may be over-inflated in the process (Mouton, Louw, & Strydom, 2013).

Thus, more research is required before making conclusions or comparisons with respect to the level of intelligence of the study sample. However, this was not the focus of the current research, which rather utilised Raven's SPM to measure problem solving ability, and any measurable changes in the problem solving ability over the research period.

6.4.2.2 Raven's SPM scores and academic achievement in the ELP

Raven's SPM was used to measure problem solving ability, and to determine if the Raven's pre-ELP test score could be a predictor for academic achievement in the ELP (measured by the Pharmacology4 summative examination mark).

For ZCL4Comp, both pre-ELP and post-ELP Raven's SPM test scores were found to show a significant, positive, moderate correlation with academic achievement in the ELP, measured by the Pharmacology4 summative examination mark (Pearson's correlation: pre-ELP: r = .350, n = 69, p = .003; post-ELP: r = .385, n = 68, p < .001). The association was found to be weaker for ZCL4Exp with a significant, positive, correlation noted (Pearson's correlation: pre-ELP: r = .245, p = .014; post-ELP: r = .307, p = .006).

When the Raven's scores were combined for the two cohorts, the pre-ELP Raven's SPM total scores showed a significant (p < .001) positive, moderate correlation (Pearson's correlation: r = .300, n = 175) with academic achievement in the ELP, as well as the post-ELP scores (p < .001, Pearson's correlation: r = .338, n = 152). Worth noting was the observation that the strength of the correlation improved post-ELP for both cohorts.

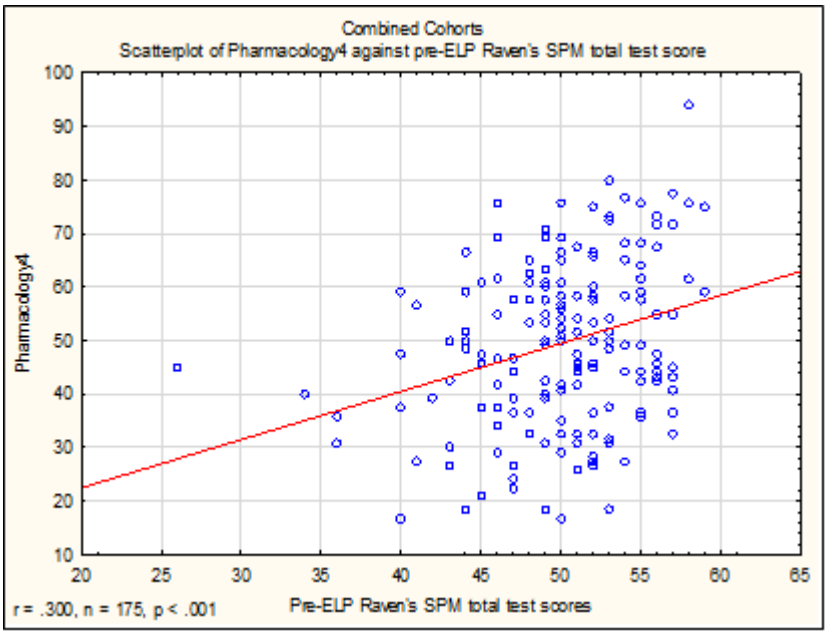


Figure 6.5

Correlation between pre- ELP Raven's SPM total scores and academic achievement in the ELP for the combined cohorts (Pearson correlation: pre-ELP: r = .300, n = 175, p = <.001)

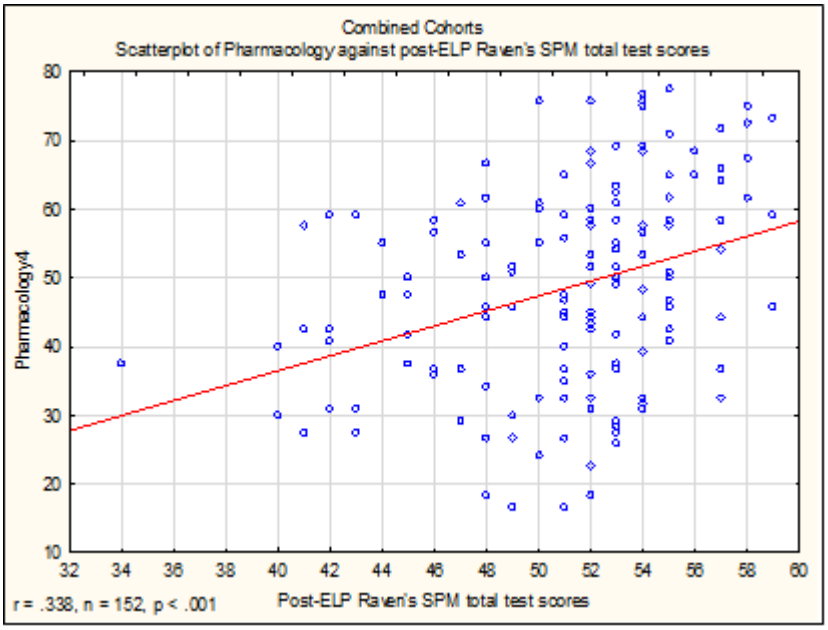


Figure 6.6

Correlation between post-ELP Raven's SPM total scores and academic achievement in the ELP for the combined cohorts (Pearson correlation: r = .338, n = 152, p < .001)

No evidence was found in the literature of the use of Raven's SPM as a measure of problem solving ability in pharmacy education. Previous research at NMMU with BPharm2 students found no significant difference (p = .100) in the observed changes in Raven's SPM scores between comparator and experimental groups (Boschmans, 2013), over a ten week intervention period. Although much of the published research in pharmacy education has focused on measuring critical thinking skills, rather than problem solving, little evidence was found in the literature of substantial changes in measures of higher order thinking skills. No major improvement was found in US pharmacy students' scores over one academic year, using two critical thinking instruments (CCTST and CCTDI) (Cisneros, 2009).

The lack of measurable change in problem solving ability in the current research needs to be considered in light of the findings of Niu, Behar-Horenstein, and Garvan (2013), who conducted a meta-analysis of empirical studies on instructional interventions to improve critical thinking skills. While the meta-analysis did not include Raven's SPM

as one of the tools used to measure critical thinking skills, the underlying intention of using Raven's SPM tool in the current research is comparable to measuring critical thinking skills. The authors came to the conclusion that although the research showed a statistically significant treatment effect of teaching critical thinking to college students, the magnitude of the overall effect size was small, with educational interventions resulting in only 0.20 standard deviations increase in the score on standardised critical thinking tests. These small increases were considered by the authors to be realistic in view of the fact that cognitive growth is a slow, cumulative process, and as such, cognitive abilities at the higher order level cannot be expected to improve dramatically over a short period of time, such as the intervention period of seven weeks in the current study. Single interventions longer than 12 weeks were seen to be more effective in increasing critical thinking abilities (Niu et al., 2013). This statement is supported by Gleason et al. (2013)'s findings that critical thinking scores improved over the PharmD curriculum, when a set of validated assessment rubrics were used to measure critical thinking and problem solving abilities across the six year programme. Of interest was that the authors highlighted problem solving as an area that needed improving.

The participants (n = 134) in the current research reiterated the need for more time to develop problem solving skills in the clinical environment, with 27.72% identifying the patient case reviews as the most difficult aspect of the ELP, and 26.73% of respondents identifying open book clinical case study assessments to be difficult. When asked in the Post-Intervention Feedback questionnaire for suggestions for future ELPs, the respondents reported that although the intervention sessions assisted with problem solving and clinical reasoning, 43.2% of respondents who provided a recommendation (n = 44) suggested more time was needed in the clinical environment, 27.3% felt clinical exposure to the hospital

setting should occur earlier in the BPharm programme and 18.2% identified a need for more practice at analysing clinical cases.

Another important point made by Niu et al. (2013) was that interventions should be designed to be compatible with the context, in order to yield more favourable results. In medical education, the need for context-relevant curricula for the development of critical thinking skills has been emphasised, as critical thinking ability underpins effective decision making and clinical reasoning in patient-centred settings (Macpherson & Owen, 2010). In the current research, the focus group participants explained how the context of the clinical setting appeared to enhance their problem solving ability:

> *Being ... in a ward actually helped you to problem solve better (P1:2014:Post-ELP)*

> *You're in the ward, you're seeing the problems, you're speaking to the doctors about the problem, getting the drug changed, you're fixing issues and now I will never forget that that drug has a problem with this and needs to be changed with this (P2:2014:Post-ELP)*

Some evidence does exist of an association between academic performance and critical thinking skills when measured using CCTST. Allen and Bond (2001) identified CCTST as a strong predictor of academic success in practice-related and clerkship programmes, while the CCTST was also found to be a significant ($p < .001$) predictor for academic success in the NAPLEX test (McCall et al., 2007) and the fourth year clerkship programme (Kidd & Latif, 2003). However, results are conflicting. Cox and McLaughlin (2014) used the Health Sciences Reasoning Test in first year PharmD students and reported a lack of moderate to strong correlation between the test scores and academic performance, as well as performance in the experiential learning programmes (APPE). The authors concluded that the measurement tool did not appear to be a useful predictor of student

success. Likewise, the WGCTA was not found to be a useful predictor of academic success in first year pharmacy student academic performance (Lobb et al., 2006).

6.4.2.3 Summary

A significant ($p < .001$), positive, moderate correlation was observed between pre-ELP Raven's SPM total test scores and academic achievement in the ELP for the combined two cohorts (Pearson's correlation: $r = .300$, $n = 175$), and thus suggests an association between problem solving ability and academic success in the ELP.

No measurable change was found in problem solving ability as a result of the intervention, when pre- and post- ELP test scores were compared in the ZCL4Exp cohort.

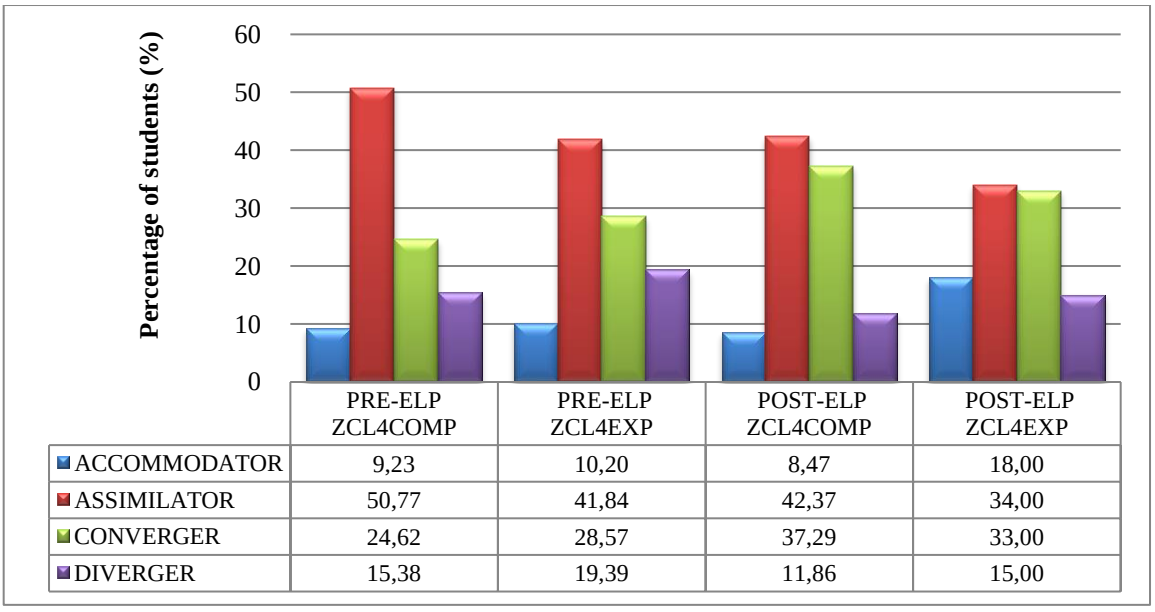
However, worth noting was the finding that the strength of the correlation between the Raven's total test scores and the Pharmacology4 summative assessment marks was seen to improve in both cohorts when pre-ELP and post-ELP test scores were compared (ZCL4Comp: pre-ELP, $r = .350$, $n = 69$, $p = .003$: post-ELP, $r = .385$, $n = 68$, $p < .001$ and; ZCL4Exp: pre-ELP, $r = .245$, $n = 106$, $p = .014$: post-ELP, $r = .307$, $n = 84$, $p = .006$).

Thus the evidence presented demonstrates that research objective 4 was met, to determine the extent to which problem solving abilities of final year pharmacy students influence academic achievement in the ELP. In conclusion, Raven's SPM may not be the most appropriate instrument for the purpose of measuring problem solving skills, and other instruments such as CCTST could be investigated, bearing in mind the recommendation of a longer timeframe.

6.4.3 Learning styles and academic achievement in the ELP

6.4.3.1. Distribution of learning styles in both cohorts and the implications for learning

Kolb's LSI was administered pre- and post-ELP in Phase One (to ZCL4Comp) and Phase Two (to ZCL4Exp) (Section 3.7.1.4). Prior to commencement of the ELP, the predominant learning style in both cohorts was found to be assimilator (ZCL4Comp: 50.77%; ZCL4Exp: 41.84%), with converger making up the second largest category in both cohorts (ZCL4Comp: 24.62%; ZCL4Exp: 28.57%). No significant difference (p = .728) in the distribution of the four learning styles was found between the two cohorts (Chi^2: df = 3, n = 163) (Table 5.25 and Figure 6.7). Post-ELP, a similar distribution of learning styles was noted, with assimilator again found to be the predominant learning style (ZCL4Comp: 42.37%; ZCL4Exp: 34.00%) followed by converger (ZCL4Comp: 37.29%; ZCL4Exp: 33.00%) with no significant difference (p = .322) in the distribution of learning styles between the two cohorts post-ELP (Chi^2: df = 3, n = 159) (Table 5.25 and Figure 6.7).



	PRE-ELP ZCL4COMP	PRE-ELP ZCL4EXP	POST-ELP ZCL4COMP	POST-ELP ZCL4EXP
ACCOMMODATOR	9,23	10,20	8,47	18,00
ASSIMILATOR	50,77	41,84	42,37	34,00
CONVERGER	24,62	28,57	37,29	33,00
DIVERGER	15,38	19,39	11,86	15,00

Figure 6.7

Distribution of learning styles in the comparator and experimental cohorts, pre- and post-ELP.

The finding of a predominance of assimilators in the two cohorts is in line with previous research conducted into learning styles of pharmacy students (Crawford et al., 2012; Gardner & Monaghan, 1996; Robles et al., 2012; Tsingos et al., 2015), pharmacists (Austin, 2004b) and pharmacy educators (Crawford et al., 2012), where convergers were also identified as the second largest category of learning style. Sharif et al. (2010) used the Honey and Mumford Learning Style Questionnaire, which categorises learning styles as activists, reflectors, pragmatists and theorists (which can be loosely aligned to Kolb's accommodator, assimilator, converger and diverger categories, respectively). On entry into the pharmacy degree programme, the largest number of first year pharmacy students scored for the reflector learning style (similar to Kolb's assimilator) (Sharif et al., 2010).

One of the earliest studies on learning styles in pharmacy education reported a predominance of convergers (50.7%) in first year pharmacy students, followed by assimilators (19.6%) and accommodators (17.1%) (Garvey, 1984). Adamcik et al. (1996) reported similar findings with final year pharmacy students, where 54% were classified as convergers and 25% as assimilators. More recently, B. Williams et al. (2013) determined learning styles in pharmacy students at Monash University, Australia (n = 240), reporting a predominance of convergers (38.3%), followed by assimilators (23.8%).

Thus, the findings of the current research, which categorised the majority of BPharm4 students (n = 163) at NMMU as assimilators (45.40%) and convergers (26.99%) is in line with reports in the literature. Pre-ELP, 72.39% of students from both cohorts were categorised as assimilators or convergers, while post-ELP, 71.70% of students fell into these two categories, although the distribution of students per category of learning style had changed. In order to understand the impact of these findings on academic

achievement in the ELP, it was necessary to explore the characteristics of these learning styles.

Characteristics of the assimilator

The assimilator uses abstract conceptualisation (AC) and reflective observation (RO) when learning, and prefers ideas and abstract concepts in order to understand information in a concise and logical format (Table 2.2). In the learning environment, the assimilator prefers reading, lectures, and time to think things through (A. Kolb & Kolb, 2005). In general, assimilators value organisation, attention to detail and prefer to learn on their own in a structured and logical manner (Crawford et al., 2012; D. Kolb, 1985). The focus group participants identified some of these characteristics when describing their initial exposure of the less structured and somewhat disorganised clinical environment:

> *In class, everything is organized. I'm an organized person. You've got your script, you store it on the computer, you put it in a file and it is filed later on. Everything has its book, everything has its file and then you come to the hospital and everything is in one file and the doctors are running around and the nurses are running around … so it's not organised like what we used to. (P3:2015:Pre-ELP)*

> *As part of my personality type, I strive to live structured and I handle things in a structured manner. If I'm given steps or instructions to follow I cope much better (P30:2015)*

> *The one thing which I find a bit difficult ... was to speak up and try and question the doctor, because I'm used to the lecture environment whereby I get given the work, I study and then I write the test ... (P7:2015:Pre-ELP)*

> *I think my problem was that I'm so used to the way pharmacology has been asked in papers in the past ... you already know what the teacher is expecting from you, which sections to study ... (P7:2015:Pre-INT)*

When the students' comments were considered together with the results of the distribution of learning styles in the two cohorts, the difficulties described by many students on commencement of the ELP were understandable, as the assimilator's approach to learning is an analytical, slower, deliberate process which is evidence-based, using a logical thought process (Croskerry, 2009; Kassirer, 2010). This preference for an analytical approach to learning and decision making would have been in direct conflict with learning in the clinical environment, where clinical reasoning and decision making tends to be intuitive and instinctive and less structured, working on hunches or recognition of trends based on past experience (Kassirer, 2010). Assimilators therefore could be expected to experience difficulties in a work environment where immediate problem solving and decision making is required (Austin, 2004b). This difficulty was described by a focus group participant:

> *In class, if you study something, you have time to recall, what you want to know ... but now in the hospital, you've got to think on your feet. If somebody asks you something, you must be able to answer. If you get a drug class wrong, that's a problem. (P3:2015:Pre-ELP)*

Characteristics of the converger

There was an increase in the number of students categorised as convergers post-ELP, in both the ZCL4Comp cohort (37.29% versus 24.62%, pre-ELP) and the ZCL4Exp cohort (33.00% versus 28.57%, pre-ELP) (Figure 6.7). Changes in the learning styles of students over time and on exposure to different learning experiences have been reported in medical students (Gurpinar et al., 2011) as well as in pharmacy students (Novak et al., 2006). Convergers (AC and AE) learn through experimentation and contemplation, can work well under pressure and enjoy problem solving and decision making (Austin, 2004b; D. Kolb, 1985). This change in learning style preferences may have arisen as students developed

confidence in the clinical environment, and their ability to identify and resolve problems grew along with their clinical decision making ability, as described by the participants below:

> *As the program went on, you became so accustomed to the files, to the patients, to the drugs, that you just pick it up so much more quickly than you were in the beginning. You actually realise the importance of having to do it, because you start finding interventions that are really beneficial to the patient, where the doses might be wrong or they are using the wrong drug. (P4:2013:Post-ELP)*

> *You're in the ward, you're seeing the problems, you're speaking to the doctors about the problem, getting the drug changed, you're fixing issues and now I will never forget that that drug has a problem with this [drug] and needs to be changed. (P2:2014:Post-ELP)*

Research into the learning styles of pharmacists found that 37.0% of convergers identified one-on-one teaching as the most preferred method (Austin, 2004b), which would have been the teaching style used in clinical rotations in the ELP. First-time exposure to this method of teaching may also have contributed to the change in preferred learning styles seen in some of the post-ELP results. Of interest was a report that medical students categorised as assimilators and convergers performed better in examinations using multiple choice format (Lynch, Woelfl, Steele, & Hanssen, 1998). Students with a preference for abstract conceptualisation (i.e. the assimilators and convergers in the current research study sample) would therefore be expected to experience difficulties when faced with the unfamiliar and less structured format of the open book, clinical case study based assessment used in Pharmacology4.

6.4.3.2 Can learning style predict academic performance in ELP?

Academic performance in the ELP was determined from the written open book, clinical case study-based assessments, using the final summative Pharmacology4

November assessment mark. No significant difference (p = .106) was found between the mean Pharmacology4 summative assessment marks achieved by ZCL4Comp cohort when students were grouped into the four categories of learning styles, using the pre-ELP learning styles scores (ANOVA, F = 2.13, n = 65) and post-ELP scores (p = .327; ANOVA, F = 1.18, n = 59) (Table 6.9).

Similarly, no significant difference (p = .141) was found between the mean assessment marks obtained by the ZCL4Exp cohort, when students were grouped according to their learning styles categories, pre-ELP (ANOVA, F = 1.87, n = 92) or post-ELP (p = .109; ANOVA, F = 2.08, n = 95) (Table 6.9).

Table 6.9
Comparison of mean Pharmacology4 summative assessment marks within the comparator and experimental groups, when grouped according to the different categories of learning styles

Categories of Learning Styles	Cohorts					
	ZCL4Comp			ZCL4Exp		
	Pharmacology4 summative November examination mark (%)					
	n	Mean	Standard Deviation	n	Mean	Standard Deviation
Pre-ELP						
Assimilator	33	42.70	14.76	39	53.21	14.23
Converger	16	51.93	12.98	26	55.13	15.58
Diverger	10	52.17	16.28	19	45.83	15.27
Accommodator	6	42.78	14.25	8	57.50	14.91
Total	*65*	*46.44*	*14.92*	*92*	*52.60*	*15.10*
Post-ELP						
Assimilator	25	43.27	15.58	33	52.22	15.15
Converger	22	48.60	12.92	31	55.40	15.64
Diverger	7	43.21	19.61	14	43.51	14.94
Accommodator	5	55.00	13.03	17	53.14	13.03
Total	*59*	*46.24*	*15.03*	*95*	*52.14*	*15.19*

ZCL4Comp pre-ELP: ANOVA, F = 2.13, p = .106
ZCL4Comp post-ELP: ANOVA, F = 1.18, p = .327
ZCL4Exp pre-ELP: ANOVA, F = 1.87, p = .141
ZCL4Exp post-ELP: ANOVA, F = 2.08, p = .109
ZCL4Comp: comparator cohort; ZCL4Exp: experimental cohort

The lack of a clear correlation between learning styles and academic performance in experiential learning, namely IPPEs and APPEs, was reported by Robles et al. (2012), when student performance was determined by subjective (competency assessment scores) and objective (final examination scores) evaluations.

Likewise, no significant relationship was observed between learning styles (measured using the Honey and Mumford LSQ) and the second, third or the fourth year examination marks of MPharm students at the University of Manchester. Although the marks were not generated from ELP's, clinical tutorials had been introduced from third year (Sharif et al., 2010). Significant weak correlations were noted between student performance in first year examinations and preferred learning styles.

Research conducted with medical students also found no statistically significant difference in examination scores across the four learning style groups (Gurpinar et al., 2010), with assimilators achieving the highest mean theoretical block examination score and accommodators obtained the highest mean PBL examination score.

In the context of the current research, the accommodators were found to have the highest mean Pharmacology4 summative assessment score in two of the four testing sessions (ZCL4Comp: post-ELP: 55.00±13.03%: ZCL4Exp: pre-ELP: 57.50±14.91%), but with only a small number of accommodators in both cohorts it was difficult to draw any conclusions at this stage, other than an observation (Table 6.9).

Apart from the pre-ELP ZCL4Comp group, the group of students categorised as divergers obtained the lowest mean Pharmacology4 assessment mark in the ZCL4Comp (post-ELP 43.21±19.61%) and ZCL4Exp (pre-ELP 45.83±15.27%; post-ELP 43.51±14.94%) groups. Divergers by nature, tend to be weak in decision making and

scientific thinking, actualisation of ideas, accessing knowledge and deciding what to learn, reaching conclusions through information and putting information into practice. Divergers generally prefer art, history, political science, literature, foreign languages and psychology over the science-based disciplines (D. Kolb, 1985). Based on these characteristics, one would expect divergers to struggle in Pharmacology4, and possibly in Pharmacology2 and Pharmacology3. Pre-ELP, only 15.38% of ZCL4Comp (n = 65), and 19.39% of ZCL4Exp (n = 92) were categorised as divergers, while the diverger group reduced in numbers post-ELP, to 11.86% in ZCL4Comp (n = 59) and 14.74% in ZCL4Exp post-ELP (n = 95). Pungente et al. (2003) identified 21.6% of first year pharmacy students (n = 116) as divergers, with 36.2% accommodators, 22.4% convergers and 19.8% assimilators. The divergers were reported to be the least satisfied with a problem-based instruction method, while convergers demonstrated the strongest preference for this learning method.

In the current research, a possible reason for the lack of differences in academic achievement across the four learning style categories may be due to the flexible nature of learning styles, so that individual students adopt a mixture of learning styles, according to the learning environment. As explained by Loo (2004), an effective learner would then be able to use any of the four learning styles in different learning situations, to maximise personal learning.

6.4.3.3 Summary

The learning styles of the study sample were found to be similar to those reported in previous studies, with a predominance of assimilators and convergers identified in the current study sample of BPharm4 students at NMMU. The quantitative data suggested that learning styles were not a useful predictor of academic achievement in the ELP.

However, the qualitative data provided evidence to support the assumption that assimilators, by their nature, may struggle with the move from traditional, lecture-based learning, to experiential learning in the clinical environment, and that exposure to a different learning environment in the clinical setting was associated with a shift in learning style preferences.

Thus in conclusion, the results demonstrated that research objective 5 was met, namely, to evaluate if students' learning styles can be used to predict academic achievement in the ELP.

6.4.4 Previous pharmacy-based work experience and academic achievement in the ELP.

Participants from both comparator and experimental groups were asked to provide information on previous work experience in a pharmacy environment, prior to commencement of the ELP (Table 5.28). Pharmacy students at NMMU are required to complete 280 hours in a pharmacy practice setting over the BPharm degree programme, which translates into 80 hours in a community pharmacy setting in BPharm2, 80 hours in a community or hospital pharmacy setting in BPharm3, 80 hours in community or hospital pharmacy setting in BPharm4 plus an additional 40 hours in either 2nd, 3rd or 4th year (Boschmans & Kairuz, 2009). Thus, on first registration for Pharmacology4 and the ELP, final year BPharm students at NMMU should have completed between 160 and 200 hours in a community and/or hospital setting. Prior exposure to work based learning through the externship hours was assumed to contribute to preparation for the ELP in Pharmacology4, along with the simulated patient case scenario practical sessions in Pharmacology3.

Community pharmacy was indicated as the setting for previous work experience by 63.92% of ZCL4Comp (n = 69) and 71.33% of ZCL4Exp (n = 104), with substantially

fewer students indicating prior exposure to the hospital pharmacy setting (ZCL4Comp: 24.74%, n = 69; ZCL4Exp: 20.28%, n = 104) (Table 5.28). A lack of available hospital-based student employment opportunities was identified as a reason for the low numbers of students gaining work based experience in the hospital environment.

Research into the influence of part-time employment in a pharmacy setting on academic success has shown conflicting results. Ho et al. (2014) suggested that a moderate amount of part-time employment could be beneficial as learning in the work environment reinforced classroom learning, but reported that PharmD students working 15-19 hours per week experienced a significant negative effect ($p < .05$) on academic performance (measured using GPA), while students working 5 - 14 hours per week did not show a significant difference in GPA from those working 0 - 4 hours ($p > .05$). In contrast Mar et al. (2010) found that previous work experience did not significantly impact on academic or clinical performance in a group of PharmD students (n = 206), as the students typically worked as pharmacy technicians or volunteers, with the majority (77.3%) working in a community pharmacy environment. As the pharmacy profession moves from technical functions to clinical activities, undergraduate student work experience in a pharmacy environment may no longer be as academically beneficial as originally assumed, due to the technical nature of the work-based activities typically performed by undergraduate pharmacy students (Mar et al., 2010). The authors also expressed concern that while the work-based activities involving technical functions provided general insight into the profession of pharmacy, there would be little or no exposure to pharmacology, cultural competency or clinical training.

This observation by Mar et al. (2010) was supported by findings in the current research, with many of the students spending much of their time at work on product-

focused activities, such as stock management (ZCL4Comp: 37.34% of students (*n* = 69) indicated "often" or "frequent", and 45.19% of ZCL4Exp (*n* = 104)) and assisting in the dispensing process through the technical functions of "pick and pack" duties (indicated as "often" or frequently" by ZCL4Comp: 73.91% of students (*n* = 69) and ZCL4Exp: 65.39% of students (*n* = 104)) (Table 5.28). Conflicting opinions were expressed by the focus group participants regarding the usefulness of time spent in the community pharmacy environment, when reflecting on the externship hours as preparation for the ELP:

> *I think, there's a big problem in the sense that the externship hours, you fill in the book, so sometimes what you will need to fill in, is already provided. The information that you need, it's just like a comprehension, just answering the passage you know ... You are not thinking on the spot, you know, you're not involved in such a situation where you have to make a critical decision there.. And then even sometimes in a pharmacy, you know sometimes, the diagnosis is not there on the script. They just give two tablets probably or just give you one antibiotic. You don't know if it's the right antibiotic for such a condition but you know sometimes you can't really probe and ask, what you really suffering from and how long has it been, because you're not the doctor. (P4:2015:Pre-ELP)*

> *In retail pharmacy ... you don't get to see the patient most of the times, because it could be just a mama bringing a script, here, please dispense this for me (P6:2015:pre-ELP)*

> *I know especially like retail, students go, and in the beginning the pharmacists don't really want to train you and you don't really know how to work on the system - so all you have to do is count out stock or pack stock and something like that. (P5:2014:Pre-ELP).*

> *You cannot really bargain that you going to get a lot of pharmacology out of retail pharmacy as compared to what would be obtainable from a clinic or hospital setting (P2:2014:Pre-ELP)*

So one thing I learned best was in terms of reading prescriptions, like I can just look at the prescription and look at the drugs and try to deal with this and link it to what's wrong with the patient (P6:2015:pre-ELP)

The frustration expressed by the participants is not limited to NMMU pharmacy students, as pharmacy students have previously described a lack of cohesion between what they are taught by pharmacy academics and the reality of pharmacy work experiences, where the focus on patient-centred care, which is heavily emphasised in lectures, is in fact, not implemented in practice (Siracuse, Schondelmeyer, Hadsall, & Schommer, 2008). Siracuse et al. (2008) also observed that work-for-pay experiences, (similar to the NMMU externship hours undertaken by the two cohorts of students) tend to be very service orientated, compared to work-for-academic credit experiences, which are more structured towards the academic outcomes required. PharmD students completing clerkships are working to *become* pharmacists, so patient-centred activities are emphasised, while pharmacy students in work-for-pay settings, are employed primarily to *help the pharmacists* by taking on the role of technicians. The work experience and subsequent impact in student learning can then be expected to differ substantially.

Several focus group participants identified the benefit gained from interaction with patients and healthcare professionals, although the majority of students from the two cohorts reported infrequent interaction with medical doctors ("seldom" or "occasionally" indicated by ZCL4Comp: 66.67% (n = 69); ZCL4Exp: 85.58% (n = 104) (Table 5.28).

I think that's what retail taught me to be was more confident with patients and doctors and other pharmacists (P4:2014:Pre-ELP)

> *I have worked in hospital and retail, so you build that confidence to speak in retail. I think that is something you get in retail that you don't get anywhere else. You have to think on your feet (P1:2015:Pre-ELP)*

The benefits highlighted by the participants, are in agreement with results reported by Valdez et al. (2013), who found that any pharmacy related work experience correlated positively with knowledge retention (determined by academic performance in examinations) in second year PharmD students. The authors also added an observation that at the University of Colorado, students lacking pharmacy experience were typically associated with academic delays, and struggled through the pharmacy programme.

Focus group participants at NMMU also recommended earlier exposure to the hospital environment before commencement of the ELP in Pharmacology4, as a means of familiarising themselves with the unfamiliar clinical setting, which appeared to be a source of anxiety for some students:

> *Being used to the surroundings and getting used to how the hospital works. Coming from a hospital background, it was easier for me but ... some people haven't really gone into a hospital before, so they don't know what to expect and how a ward runs (P1:2014:Post-ELP)*

> *Please start/initiate programme in 3rd year so students are more familiar with hospital pharmacy or role of pharmacist in hospitals (P15:2013)*

Pharmacy student feedback on ELP's frequently identifies a need for earlier exposure to practice sites, as recommended by 27% of students (n = 44) in the current research. Ackman and Mysak (2009) described the implementation of a structured two week hospital-based rotation for second year pharmacy students in Canada, aimed at providing direct patient care experience in addition to exposing students to the clinical role of the hospital pharmacist. Feedback from the students specifically highlighted the

difference observed in the impact of pharmacists on patient care in the hospital setting, compared to community pharmacy. Positive feedback was also received for an early hospital exposure programme introduced in the second year of a Bachelor of Science Pharmacy programme in Canada, with students obtaining a better understanding of the concepts of problem-based learning in a patient setting (Battistella, Seki, Wong, Arora, & Musing, 2004). As Kolb's theory suggests, learning is most effective when personally experienced (D. Kolb, 1984) and as such, supports the introduction of concrete experiences early in the undergraduate pharmacy programmes.

6.4.4.1 Summary

In conclusion, the results presented suggest that prior work exposure in a pharmacy environment does contribute positively to the ELP, although the student experience varied considerably. The findings suggested that those students who were exposed to inter-professional communication during previous work experience, reported improved self-confidence when engaging in inter-professional communication in the ELP. However, not all students were exposed to this activity in the pharmacy work based setting, which resulted in a lack of self-confidence and high anxiety levels as the ELP commenced.

This finding was also applicable to activities involving direct patient care during previous pharmacy work experience, where a greater involvement with patients encouraged the development of self-confidence and inter-personal communication skills which were then applied during the ELP. The experience gained in reading prescriptions and assisting with dispensing functions would also contribute to learning in the clinical setting. Earlier exposure to the hospital setting was identified as potentially beneficial for familiarisation of students to the new workplace environment and understanding workflow in the wards and dispensary.

Thus the results presented provide evidence to show that research objective 6 was met, namely to investigate if prior work exposure in a pharmacy practice environment in the form of externships influences academic achievement in the ELP.

6.5 RESEARCH SUB QUESTION FOUR

Do the assessment methods used in summative pharmacology examination papers in the preceding academic years prepare pharmacy students for clinical case-based assessments, which require application of knowledge through problem solving and clinical decision making?

Pharmacology2 and Pharmacology3 summative written November examination papers were retrospectively reviewed in order to categorise the questions according to Bloom's taxonomy, using a modified method described by Kim et al. (2012). The intent was to determine the percentage of marks allocated to questions involving higher order thinking skills such as application of knowledge and analysis. The methodological approach used was described in Chapter Three (Table 3.3) and results were presented in section 5.8.

Pharmacy students at NMMU are introduced to simulated clinical case scenarios in Pharmacology2, with the scenarios increasing in complexity in Pharmacology3 practical sessions (Table 1.1). The written formative and summative Pharmacology2 and Pharmacology3 assessment papers encourage application of knowledge through problem identification using clinical patient-based scenarios. Yet Pharmacology4 students described experiencing difficulties when expected to apply pharmacological knowledge, both in the clinical setting and the open book clinical case study based assessments (sections 4.3.3.3 and 4.3.4.1).

Results from the retrospective review (Table 5.29) provided evidence of questions in all four pharmacology summative assessment papers that required application of knowledge, both at the Pharmacology2 and Pharmacology3 levels. Worth noting was the lack of standardisation in the content of the Pharmacology3 papers in that questions devoted to application and analysis made up 40.8% in 2013 Pharmacology3 paper but only 31% of the 2014 Pharmacology3 paper. Students from both cohorts (ZCL4Comp and ZCL4Exp) were therefore exposed to summative assessments with questions dedicated to application of knowledge, with a greater percentage of marks allocated in Pharmacology3 compared to Pharmacology2 summative assessments.

A similar breakdown in the type of questions was reported by Fitzpatrick, Hawboldt, Doyle, and Genge (2015) in a review of two therapeutics courses in a professional pharmacy degree programme, in order to align the course objectives and assessments in terms of higher order cognitive processes. The assessments utilised short answer and multiple choice questions. The cognitive skills were categorised using the revised Bloom's Taxonomy (L. Anderson & Krathwohl, 2001). The authors reported that 66.3% of the assessments in both therapeutics courses used lower-order thinking processes, while only 33.7% could be categorised as higher order thinking (considered to be the processes of apply, analyse, evaluate and create).

However, feedback from the focus group participants and the Pharmacology4 Module Feedback questionnaire suggested that the BPharm4 students still felt unprepared when required to integrate and apply knowledge, both in the clinical setting and in the open book case study-based assessments, with numerous requests for more practice. Similar difficulties were observed in BPharm4 students from Namibia, where the use of mock patient cases as an assessment tool for clinical pharmacy skills, was found to be

associated with low marks (ranging from 38% to 66%, with an average mark of 54%, *n* = 14) (Rudall et al., 2015).

The difficulty experienced by most of the current research's participants with the Pharmacology4 case study-based assessments, which required the higher order level thinking skills of synthesis and evaluation, was voiced by this participant, and supported by evidence from the retrospective review.

> *Open book tests are a huge leap from 3rd year level to 4th year. Adequate preparation should be done (P35:2013)*

One participant identified how the emphasis on pharmacological knowledge changed in the clinical setting. This observation by the NMMU focus group participant conferred with a study by Keijsers et al. (2014) who compared pharmacology, applied pharmacology and pharmacotherapy knowledge between medical and pharmacy students. The Masters level pharmacy students (*n* = 151) obtained higher test scores for basic pharmacology knowledge (77.0±10.3%, compared to 68.2±9.8% for medical students, *n* = 451), although knowledge of applied pharmacology and clinical pharmacology was found to be similar between the two student groups, prior to clinical placements.

The NMMU focus group participants described conflict between the emphasis when pharmacology was taught in lectures, compared to what was expected in practice, when students were required to apply pharmacological knowledge in the clinical setting.

> *If you ask second year pharmacy student, what is pharmacology all about, they will say the mechanism of action, but when you get into practice, you realise that ... what you are really looking out for are multiple side-effects in a patient and you are looking out for contraindications, can they really use this drug? (P10:2013:Post-ELP)*

The feedback from the students therefore justified the need for the supplementary academic support sessions which were introduced as the intervention (section 4.3.5), as the academic support sessions were able to provide a more structured approach in order to facilitate the development of the higher order cognitive skills of synthesis and evaluation which were required for the Pharmacology4 formative and written assessments. Questions requiring use of the cognitive skills of synthesis and evaluation were not utilised in Pharmacology2 or Pharmacology3 summative examination papers, and only one of the four papers had a question requiring the cognitive skill categorised as analysis. This was to be expected due to the very nature and timing of these assessments in the BPharm curriculum at a point when the development of factual knowledge and comprehension needs to occur (Richir et al., 2008). However, as suggested by Richir et al. (2008), gains in knowledge when learning clinical pharmacology and therapeutics, should be accompanied by opportunities to apply the knowledge, as seen with the simulated clinical case practical sessions completed by the NMMU pharmacy students during Pharmacology2 and Pharmacology3. The following comment by a focus group participant confirmed this viewpoint.

> *Like our 3rd year practicals, if you really reflect and look back, they prepared us in a way, like you get a pregnant lady, you know, you're given such scenarios in your 3rd year practicals (P4:2015_pre-ELP)*

Also in the context of medical education, Norman (2005a) suggested that acquired knowledge was critical for predicting physician performance, since application of knowledge for the purpose of problem solving and clinical reasoning requires a solid foundation of factual knowledge. This concept was in agreement with Kim et al. (2012)'s observation that a student may possess good critical thinking skills but not have sufficient

factual knowledge on multiple topics to be able to score well in assessments involving analysis, evaluation or synthesis, a comment that was supported by student feedback.

6.5.1 Summary

Although the evidence from the retrospective review showed exposure to questions requiring application of knowledge, there was a noticeable shift in the use of the highest order cognitive domains described in Bloom's taxonomy, for assessments used in Pharmacology4, compared to Pharmacology3. This observation was substantiated by numerous appeals from the study participants for more exposure and practice, and earlier introduction to the open book format of assessment. While the need for gains in factual knowledge and comprehension cannot be overlooked at the undergraduate level of pharmacology education, the need for supplementary academic support in Pharmacology4 was evident in order to support the students in the development of the cognitive skills required clinically when problem solving.

Thus the results presented demonstrate that research objective 7 was met, which was to determine the extent to which students are expected to apply pharmacological knowledge in summative examination questions used in undergraduate second and third year pharmacology examination questions.

6.6 RESEARCH SUB QUESTION FIVE

What are the students' experiences of the experiential learning programme?

Data pertaining to the students' experience of the ELP was obtained from the Pharmacology4 Module Feedback questionnaire and the focus groups (Sections 4.2 and 4.3.3). The emergent themes focused on the students' experience of the clinical environment itself, inter-professional relationships and professional identity, integration

of knowledge and application to patient care and self-perceived level of preparedness. Attitudes and expectations of the students towards the ELP were in general, positive and realistic and in line with the module's objectives.

> *To look at a holistic approach of the pharmacological management of the individual and we are always taught in class that we need to individualise patients so looking at the hospital program it will also gonna give us that opportunity to be able to look at patients individually (P2:2014:Pre-ELP)*

> *it's now at a point where theory meets practical so you have to now take what you've learnt and put it into application (P2:2014:Pre-ELP)*

> *I'm looking forward to the hospital program mostly because I want to help and assist people (P3:2014:Pre-ELP)*

However, areas of concern were raised regarding the students' experiences of the ELP. In South Africa, revisions to the undergraduate pharmacy curricula have embraced the clinical, patient-centred role of the pharmacist, yet in the hospital setting, there is a scarcity of clinically orientated pharmacy practitioners, and particularly in the public sector hospitals where NMMU's ELP is situated. The lack of adequately trained, clinically-orientated pharmacists as mentors for undergraduate students has also been reported in Namibia (Rudall et al., 2015). Both cohorts of NMMU final year pharmacy students appeared to lack a professional identity for the clinical role of the hospital pharmacist. One participant even expressed a desire for a role model:

> *let them [the clinical placement coordinators] do the work, let them screen the file, let them talk to the patient, let them talk to the doctor, let them talk to the nurse … so I could see how things are done (P3: 2015:Post-ELP).*

In the absence of clinical pharmacists in the hospital-based ELP, NMMU has successfully utilised the available resources of medical doctors and nursing staff from the

four hospitals, as well as the hospital pharmacists, for the past sixteen years. Nuffer et al. (2015) reported on an inter-professional IPPE course in Colorado, where third year pharmacy students were partnered with non-pharmacist practitioners (mainly primary care physicians and nurses) in a community practice based environment, with mutually beneficial outcomes. Students reported improved self-confidence through the interactions, while the providers requested to take on pharmacy students for longer periods of time during the fourth year APPEs.

At NMMU, focus group participants described a feeling of inferiority and being overwhelmed when first entering the clinical environment, as they compared their knowledge to that of the medical doctors and found themselves lacking. This feeling of subordination has previously been reported as an inter-professional barrier between community pharmacists and general practitioners in the primary care setting in Ireland (Hughes and McCann (2003). However, the NMMU pharmacy students subsequently developed a better insight into the role of the pharmacist in the healthcare team on completion of the hospital-based ELP. Inter-professional discussions were found to contribute to improved student confidence and a deeper understanding of the clinical management of the patient, and the pharmacist's role in the clinical team.

Students described that as the ELP progressed and the clinical activities in the ward were repeated on a daily basis, clinical skills developed and they found it easier to integrate the clinical information and identify medicine-related issues and possible pharmacist interventions to follow up on. In the Netherlands, pharmacy students demonstrated a better basic knowledge of pharmacology compared to medical students, who had better prescribing skills, but there was little difference in applied knowledge between the two student groups (Keijsers et al., 2014). The results of the current research support findings

that clinical application of pharmacological knowledge comes with repeated exposure to clinical practice experience (Richir et al., 2008; Tichelaar et al., 2015).

Frustration was expressed at the start of the ELP, with some students feeling that they were too focused on completion of the clinical activities. This feeling of an overly structured ELP can limit learning and relationship building initially as students grapple with the new environment and task completion (Owen & Stupans, 2009). Feelings of anxiety, stress and apprehension were expressed by several students as they struggled to analyse and integrate clinical information in the unfamiliar setting. As explained by A. Kolb and Kolb (2005, p. 208), "negative emotions like fear and anxiety can block learning, but positive feelings of attraction and interest may be essential for learning".

> *my biggest worry ... when you walk into a ward, what will you be able to absorb or to extract or what will you be able to use to write up the SOAPs. I think that's where the anxiety and the nervousness would come from (P4: 2014:Pre-ELP:)*

> *you go there with a fear of so many things, you don't know what are you going to meet there, and then how are you going to cope with it (P2: 2015:Pre-ELP).*

An unexpected finding of the present research was the general feeling expressed by the NMMU final year pharmacy students that experiential learning in the community pharmacy setting did not prepare them for the hospital-based clinical placements. This appeared to be due to a lack of involvement in direct patient care, with students describing their experiences as limited to the technical function of dispensing the prescription, often with little if any opportunity for patient counselling. Surprisingly, the community pharmacy setting was not seen as an environment where students would use their pharmacological knowledge, as one student explained:

I feel like it is more about applying the pharmacy practice knowledge when you're in retail than applying your pharmacological knowledge (P1:2015:Pre-ELP)

This lack of confidence in working with patients was also demonstrated by the initial hesitancy in approaching and interacting with patients in the ward. In addition, the community pharmacy setting appeared to discourage rather than facilitate interactive communication with medical doctors, so that students entered the hospital setting with negative perceptions and feelings of inadequacy. As mentioned by Horsburgh, Lamdin, and Williamson (2001), the timing of learning about different professional roles is not clear in the literature but it is of concern that final year pharmacy students in the current study had already developed perceptions and attitudes which impacted negatively on their professional identity at this early stage.

Another notable finding was the initial perception that the doctor's clinical decision regarding prescribed medication should not be questioned by a final year pharmacy student. The ease with which students initiated inter-professional discussions about a patient's medication appeared to develop with time as the students became more familiar with their role in this setting, supporting the need for more inter-professional interaction during undergraduate pharmacy training.

Initially, self-perceived concerns were expressed about a lack of preparedness and lack of confidence in their ability to apply their knowledge, but appeared to improve as students started to integrate the clinical information, and link the condition to the medication prescribed, gaining insight into the rationale for the choice of medication prescribed. The feeling of unpreparedness may also have been a result of student apathy towards the series of introductory lectures and the manual provided for the clinical placements which detailed the tasks and clinical activities to be performed. This lack of

pre-placement preparation has previously been reported with MPharm students in the UK (Nation & Rutter, 2011).

6.6.1 Summary

To summarise, the introductory hospital-based ELP was found to be a worthwhile learning experience with participants in agreement that it helped with the integration and application of knowledge, as the following participant explained, "*hospital rounds helped a lot to apply your drug knowledge (P5:2015:Post-ELP)".* Many participants felt an initial introduction to the hospital environment should occur earlier in the BPharm programme, expressing a need to merely observe a ward round, and gain familiarity with the medical charts. Mounting evidence in the literature also supports early rather than later clinical placements (Ackman & Mysak, 2009; B. Williams et al., 2013). The value of experiential learning was described by participant 3 when reflecting on the ELP*, "you don't realise through this experiential* [programme] *that you actually really learn" (P3:2015:Post-ELP).*

One of the underlying concerns around this ELP from a pharmacy educator viewpoint has been the lack of clinical pharmacists to accompany the students in the wards. Although this was evident from the students' comments, the required learning objectives of the ELP were still met and the students soon identified where the pharmacist could contribute to patient care. The participants identified that the ELP provided definite positive benefits in terms of developing clinical skills and confidence for problem solving, integration and application of knowledge and clinical decision making. The positive impact of interacting with different healthcare professionals was realised although difficulties were experienced initially. As one participant summed up for the group:-

> *the hospital program [ELP] ... it's amazing, you learn, you revise, you integrate ... it's just a good balance of everything you need to do in pharmacy as a career. The decision making thing is great because as a pharmacist, you have to make a decision ... instead of just knowing, there's a side-effect, that's an interaction. I think knowing the interaction and then what would you do, would finishes it and prepares us (P4:2014:Post-ELP)*

The review and evaluation of the ELP, viewed from the students' perspective, enriched and enlightened the current research, adding a new dimension and added depth to the findings, which will be invaluable in future ELP development. No truer word was spoken than by Professor Lawrence H. Summers of Harvard University, "The only true measure of a successful educational model is our students' experience of it" (L. Summers, 2003, p. 64).

The results presented therefore met research objective 8, which was to explore the students' experience of the ELP in order to describe student attitudes towards, and expectations of the clinical placements.

6.7 RESEARCH SUB QUESTION SIX

To what extent could supplementary academic support sessions influence academic achievement in the ELP?

6.7.1 Design and structure of the supplementary academic support sessions

The intervention was developed from qualitative data obtained from focus group sessions and the Pharmacology4 Module Feedback questionnaire (Chapter 4). The intervention was then implemented in Phase Two (2015), in the form of supplementary academic support sessions introduced for the last seven weeks of the 15 week ELP. The emergent themes obtained from the students' feedback that led to the design of the

intervention were: group work; active participation; and integration of clinical information. The data subsequently led to the identification of four key elements for the intervention, based on student-identified needs: a more structured and systematic approach to patient case analysis; more practice with case analysis, with opportunity to practice analysing patient cases as an individual and in groups; immediate feedback and discussion; and active participation in the case analysis.

The format of the academic support sessions emphasised active participation of all the students in the case analysis, in order to enhance learning. As Stice (1987, p. 292) explained "Students retain 10% of what they read, 26% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say and 90% of what they say as they do something". Active learning as a teaching approach, requires active participation of all students in carefully selected activities that are learner-centered and involve discussion and case-based applications in order to stimulate higher order thinking, critical analysis and problem solving (Gleason et al., 2011). Today's learners should be encouraged to be active constructors and organisers of their own knowledge, rather than passive recipients of content-heavy knowledge delivered by expert lecturers (Peeters, 2011). The group discussions and researcher-led feedback and question time at the end of each session proved to be far more interactive and participatory (when compared to the group-led case presentation format used in the morning report-back sessions), involving student-student as well as student-researcher interactions. The active learning strategies utilised were seen to encourage peer learning, as students helped each other solve problems (Gleason et al., 2011).

> *You have other people to help you and to see and direct you in how you should think, and you can talk to the lecturer, and you can see how other students are approaching the same case that you are all working on (P4:2015:Post-INT)*

> *I learn by doing and seeing and observing ... so I think that's why it helped me so much, to see it done. I remember it and I've learnt it and I can now apply what I've learnt. (P2:2014:Post-ELP)*

When the test scores obtained from Kolb's LSI were considered in terms of the preferences of students for the *active-reflective* or *abstract-concrete* approaches to learning (Table 5.27), a significant difference (p = .012) was observed between the pre- and post-ELP mean test scores on the *active-reflective* (AE-RO) axis for the ZCL4Exp group, although this was of small practical significance (Cohen's d = 0.26). No significant difference was observed for ZCL4Comp (p = .062). The finding suggests a shift in learning preferences in the ZCL4Exp group towards active experimentation, which could be a result of exposure to the active learning strategies employed in the academic support sessions.

The immediate feedback at the end of the session was identified by several students as valuable, as the feedback prompted reflection on the case analysis approach taken by the individual student, which then led to self-assessment on completion of each case-based analysis session.

> *The idea of giving the feedback is very important as it shows you where you went wrong ... sometimes I feel that we need more time to spend and check what is happening, we need more of those scenarios and stuff, and maybe give us help in that way. (P6:2013:Post ELP)*

Embo, Driessen, Valcke, and Van Der Vleuten (2014) described a similar result with undergraduate midwifery students who undertook reflective activities during work-based learning activities. The midwifery students preferred immediate reflection as it provided the opportunity to stop, re-consider actions taken, identify mistakes and difficulties experienced, and adjust the approach taken for the next action. Reflection is an invaluable component of experiential learning (A. Kolb & Kolb, 2005), although in the

current research, reflection usually occurred on completion of the ELP at the end of the academic year when the Pharmacology4 students submitted a portfolio of clinical evidence for assessment purposes. Learning could be enhanced if this reflection occurred on completion of each two week clinical placement.

A preference for group discussions was expressed by many of the students and can be understood when the context of the intervention is examined, in that students had moved from traditional lecture-based, group-led case presentations, to a format of active involvement in patient case analysis, enhanced by peer learning. As described by A. Kolb and Kolb (2005, p. 207), "human beings naturally make meaning from their experiences through conversation, yet genuine conversation in the traditional lecture classroom can be extremely restricted or non-existent". The lack of student engagement in the group-led case presentations was evident from the feedback obtained from the students.

> *I have a problem because I can't focus the whole time, there's a lot of noise and I don't listen. I won't lie, I don't listen to the whole presentation. (P2:2015:Post-INT)*

> *I know our group sat and did that week's SOAP in that session … (P3:2015:Post-INT)*

Student engagement in learning typically involves an approach which is interactive, problem based, and encourages participation and contributions from everyone, which then leads to the development of critical thinking skills (K. Hudson, 2015; Rosenthal et al., 2010). The academic support sessions were, therefore, less formal, and far more student-centred, with notable increases observed in the level of student-lecturer interaction and student-student interaction. Vygotsky's Social Development Theory (1978) proposed that learning is a social process, which was evident from the group work during the academic support sessions and the resultant discussions, which were identified

by the students as a positive learning technique. The dynamic and interactive nature of active learning models have been shown to increase creative thought and problem solving abilities (Blouin et al., 2008).

The design and format of the intervention (Sections 4.3.4 and 4.3.5) was similar to that of team-based learning which has been used successfully in medical (B. M. Thompson et al., 2007) and pharmacy education (Beatty, Kelley, Metzger, Bellebaum, & McAuley, 2009). Team based learning (TBL) has been defined as an active learning and small group instructional strategy that provides students with opportunities to apply conceptual knowledge through a sequence of activities that includes individual work, teamwork and immediate feedback, and is typically used for large classes (> 100 students), incorporating multiple small groups of 5 to 7 students in a single classroom (Parmelee, Michaelsen, Cook, & Hudes, 2012). Three key components characterise TBL, namely that there is individual advance student preparation; individual and team readiness tests that enforce accountability; and lastly, the majority of class time is focused on decision-based application assignments done in teams.

The structure of the intervention in the current research was developed using the feedback from the students and was, therefore, based on the needs identified by the students. The academic support sessions, therefore, did not include advance individual student preparation or readiness assurance tests, although the TBL concept of a large class, working in multiple groups, facilitated by one instructor was utilised.

Many of the components used in the intervention have also been successfully applied in problem based learning (PBL), which is known to be an effective approach in pharmacy education for enhancing student learning (Cisneros, Salisbury-Glennon, & Anderson-Harper, 2002; Hogan & Lundquist, 2006; R. Summers et al., 2001; Whelan,

Mansour, Farmer, & Yung, 2007). However, the disadvantage of PBL is the facilitator-based, small group format, which would not be feasible in the large class setting at NMMU.

The intervention also incorporated principles of case-based learning (CBL) which is an active learning strategy for large classes, where active participation during discussion of the cases is encouraged through audience-response systems or clickers (Gleason et al., 2011). However, the structure of the academic support sessions was not solely limited to CBL due to the elements of individual and group work times that were included to enhance active participation.

Thus there is substantial evidence in the published literature that supported the inclusion of the different components of the academic support sessions, although the active learning strategy used did not fall neatly into one specific type of strategy, due to the inductive approach used in the design of the intervention.

Many of the students expressed a desire for more support and assistance in the patient case analysis and clinical reasoning process.

> *I am lacking when it comes to making clinical decisions. That's where the problem is ... time management and the clinical decision making. What to start or change? (P1:2015:Post-INT)*

> *I'm a person like who wants to work hard and do what is expected of me, so thinking out of the box sometimes can be a little bit challenging, as usually I work well within guidelines, so okay go and do this that that and this (P2:2015:Pre-INT)*

> *I think for some people, it's like you're staring at it, but you're like, I don't see anything, you know, what's wrong, what are you talking about, so I think it forces you that okay, there has to be something, think, so I think that would be really good*

> *because some people have a hard time identifying [problems] because you may know the drug, this works like this, and this does this and it has an interaction with this but now you are looking at a patient who is pregnant, (P3:2014:Post-ELP)*

> *This [decision making] was often a problem, because I could identify the problems or triggers but I didn't know what to do about them. (P96:2015)*

The student-identified need for repetition and more practice in case analysis was justifiably valid when the development of clinical reasoning skills, and more specifically, therapeutic reasoning was considered (Durning et al., 2013). Repeated exposure to patient cases promotes the development of treatment scripts (Richir et al., 2008), which are stored and later retrieved for processing though analytical or non-analytical learning (Croskerry, 2009). Thus, in the patient-focused clinical setting of the hospital-based ELP, an assumption can be made that pharmacists need to apply the same therapeutic reasoning processes in order to evaluate the appropriateness of medicines. However, the one key element that was often lacking in the hospital setting during the ELP, in the absence of clinical pharmacists, were discussions on the appropriateness of the prescribed medicines. The NMMU pharmacy students accompanied the medical doctors on ward rounds and participated in discussions on the medical history, symptoms and diagnosis, but often no or scanty discussion occurred with respect to the choice of treatment. The need for more support in the form of pharmacotherapy-based discussions was therefore met during the supplementary academic support sessions. Reinforcement of a structured and systematic approach to patient case analysis through repeated exposure to practice examples of patient cases in the academic support sessions, resulted in the majority of the students indicating that they felt more equipped for integration of knowledge when analysing cases (91.0%; *n* = 104; Post-Intervention Feedback questionnaire). When considered in light of script theory and dual process theory (Durning et al., 2013), the repeated exposure to cases over the duration of the intervention and the ELP, would facilitate the development of treatment

scripts and the accumulating clinical knowledge was then organised and stored for subsequent retrieval for application to the next patient case.

Context-learning, in which learning takes place in a setting that is similar to the future professional's work environment, has also been highlighted as conducive to the development of treatment scripts (Richir et al., 2008; Tichelaar et al., 2015). Ideally this would occur in the clinical setting, but can include working in small groups, using real patient case histories, as used in the intervention design. In this setting, the storage of pharmacotherapeutic knowledge, in the context in which the knowledge will be applied, is thought to improve the speed and quality of recall (Bissessur et al., 2009).

The difficulties described by the students may, therefore, be in part due to inexperience in clinical decision making, so that initially, the inexperienced pharmacy students preferred to follow an analytical reasoning process, relying on evidence and a logical thought process (Croskerry, 2009), rather than following the more intuitive, less structured approach that is characteristic of clinical reasoning and decision making (Kassirer, 2010). The slower analytical approach to clinical reasoning and problem solving would be compounded in the context of the current research, by the finding that the predominant learning style in both cohorts was assimilator, which by nature, tends towards analytical thinking. With these attributes in mind, the students' need for a more formal structured approach at the introduction of the ELP was understandable, in order to overcome the initial difficulties associated with a lack of clinical experience and a need for structure and organisation. As shown by the current research, introduction of supplementary academic support sessions using an active learning strategy with a structured, systematic approach to patient case analysis, reinforced through repetition, with

immediate feedback, appeared to encourage the development of student confidence as problem solving and clinical reasoning skills developed.

6.7.2 Did the intervention influence academic achievement in the ELP?

The impact of the intervention was evaluated using qualitative data obtained from the Post-Intervention Feedback questionnaire, administered to the Phase Two (2015) cohort and the post-intervention focus group, conducted post-ELP with a subset of the Phase Two (2015) cohort. An overwhelming majority of the students from ZCL4Exp (91.0%, n = 104) identified that the academic support sessions helped develop case analysis skills, while 6.7% (n = 104) specifically mentioned enhanced decision making ability (Table 4.11). Aspects that were identified by the ZCL4Exp (n = 104) as beneficial for learning were active participation in case analysis (23.9%), the systematic and structured approach (14.2%), peer learning (10.7%), inclusive nature of the sessions (9.6%), the educational value (8.1%) and immediate feedback (9.1%) (Table 4.11 and 4.12). Student feedback was, therefore, positive, other than complaints that the academic support sessions should have been introduced earlier in the ELP (7.1%), before the first formative assessment (Table 4.12).

In addition, the intervention was also evaluated quantitatively, by comparing the Pharmacology4 summative November examination marks achieved by ZCL4Comp, who were not exposed to the intervention, and ZCL4Exp, who participated in the intervention. A statistically but not practically significant difference (p = .030) was noted in the mean summative Pharmacology4 marks between the ZCL4Comp (n = 69) and ZCL4Exp groups (n = 103) (Student's t-test, t-value = -2.20, n = 172, Cohen's d = 0.34) (Table 5.20). Since the ZCL4Exp group participated in the intervention, while the ZCL4Comp group did not, the finding suggests that the intervention contributed positively to significant changes in

academic achievement in the ELP, although the changes were of small practical significance.

When the students in the two cohorts were sub-grouped according to the rate of academic progression through the BPharm programme, an interesting observation was noted (Table 6.4). A practically significant difference (p = .025) was seen in the mean Pharmacology summative assessment marks obtained by ZCL4Comp, when the cohort was sub-divided into the students who had progressed at the normal rate, within the minimum period and the group which had a slower rate of progression and exceeded the minimum period (ZCL4Comp: 50.06%±13.90 versus 41.86%±15.73 respectively) (Student's *t*-test: *t*-value = 2.29, n = 69, Cohen's d = 0.56). However, this difference between the mean assessment mark was not evident in the ZCL4Exp cohort (mean Pharmacology assessment mark for normal progression: 52.06±15.48% versus slower academic progression: 51.00±14.41%) (Student's *t*-test: *t*-value = 0.34, n = 102, p = .731). Also worth noting when considering the rate of academic progression, was the significantly higher (p = .004) percentage of ESL students in ZCL4Exp (70.84%, n = 103), compared to ZCL4Comp (49.28%, n = 69) (Chi^2 = 8.20, df = 1, Cramer's V, 0.22).

A possible explanation could be that students with a slower rate of progression through the BPharm programme were in need of additional academic support in the final year and, therefore, benefited from the intervention, as demonstrated by the fact that there was no difference in the mean Pharmacology4 mark between the two ZCL4Exp subgroups, in contrast to the significant difference noted between the sub-groups in ZCL4Comp, who were not exposed to the intervention.

6.7.3 Summary

The findings presented in Chapter Four described the design, development and structure of the intervention, as well as the students' experience of the academic support sessions. Quantitative results presented in Chapter Five were used to determine if the intervention had influenced academic achievement in the ELP. The intervention was designed using qualitative data obtained from the students, and was successfully implemented in Phase Two of the study.

The success of the intervention was evident from the qualitative data obtained from the Post-Intervention Feedback questionnaire and post-intervention focus group, while the quantitative data provided evidence of a statistically significant improvement in academic achievement in the ELP, although this was found to be of small practical significance.

Thus, the results presented provide evidence that research objective 9 was met, namely to develop, implement and evaluate an intervention aimed at providing supplementary academic support during the ELP.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

In recent years, curricula in pharmacy education have undergone extensive revision in order to meet the profession's need for pharmacists able to deliver patient-focused pharmaceutical care services which optimise the medication-related needs of patients. The changing professional role of the pharmacist in the workplace has driven the need for additional skills development in undergraduate pharmacy education, in areas such as clinical therapeutics, problem solving and inter-professional teamwork. The expanding role of the pharmacist has also highlighted the need for increased exposure of undergraduate pharmacy students to experiential learning opportunities in patient-centred environments. At NMMU, this is achieved through the completion of externship hours in BPharm2 and BPharm3, and in BPharm4 through clinical placements in the fifteen week, hospital-based ELP during the Pharmacology4 module. Yet, the final year BPharm students, like many students from other healthcare professions, struggle with the application and integration of pharmacological knowledge when required to identify and resolve medication-related problems in the clinical setting. In light of the difficulties experienced, the current research explored the need for an intervention in the form of additional academic support in the ELP and, investigated the influence of factors which could impact on academic achievement in the ELP.

Student feedback obtained from the post-ELP Pharmacology4 Module Feedback questionnaire as well as focus group sessions provided sufficient qualitative data to confirm the need for an academic support-based intervention, and guided the subsequent design and structure of the intervention. In Phase Two, the intervention was implemented and completed by the experimental cohort (ZCL4Exp) during the ELP. The comparator

cohort (ZCL4Comp) completed the ELP as usual in Phase One, with no intervention during the ELP. Pre- and post-ELP testing in Phase One and Phase Two provided quantitative data for comparative purposes, in order to investigate several factors as possible predictors of academic achievement in the ELP.

7.2 SUMMARY OF KEY FINDINGS

In order to consolidate the key findings of the research, the results will be summarised into three areas: the students' experience of the ELP; the need for, and nature of, the intervention to academically support students during the ELP; and the predictors identified for academic achievement in the ELP.

7.2.1 Students' experience of the ELP

Qualitative data was obtained from the three phases of the research, utilising the Pharmacology4 Module Feedback questionnaire (post-ELP) and focus group sessions (pre- and post-ELP). The data provided rich, in-depth descriptions of the lived experiences of the participating students, prior to and on completion of the ELP. Attitudes and expectations of the students towards the ELP were generally positive, realistic and in line with the Pharmacology4 module objectives, as summarised by this focus group participant, "*The hospital programme will provide us with an opportunity to pull everything together and look at a holistic approach to the pharmacological management of the individual (P2:2015:Pre-ELP)".*

Areas of concern that were highlighted during the discussions related to difficulties experienced in the integration of pharmacological knowledge during patient case analysis; feeling overwhelmed by the unfamiliar clinical setting; feelings of inferiority and subordination, compounded by the lack of clinical pharmacists as role models in the

clinical environment; and a feeling of unpreparedness for direct patient care involvement. Student feedback on completion of the ELP identified that inter-professional discussions on disease states and pharmacotherapeutic options were felt to enhance learning as well as students' understanding of the role of the pharmacist in the clinical context. Repetition of the various clinical activities performed over the duration of the fifteen week ELP was also found to contribute to building student confidence as clinical skills developed. The overall experience of the ELP was summed up by this participant:

> *the hospital programme … it's amazing, you learn, you revise, you integrate and the SOAPs and everything, it's just a good balance of everything you need to do in pharmacy as a career. The decision making thing is great I think, because as a pharmacist, you have to make a decision, which will either benefit the patient or you can bring them harm, and that's exactly what we get in our open book [assessments] (P4:2013:Post-ELP)*

7.2.2 Supplementary academic support in the ELP (the intervention)

Hospital-based activities and clinical case-based assessments requiring application of knowledge and clinical reasoning were identified by 71.28% of the study sample (n = 134) as the most difficult aspects of the ELP. The qualitative data strongly supported the need for an academic support-based intervention. The format of the case-based intervention, using active learning strategies, was identified by 95% of the ZCL4Exp cohort (n = 104) as preferable to the lecture-based, group-led case presentation format previously used in the ELP report-back sessions, as the following participants described:

> *In [the academic support session] ... you have other people to help you and to see and direct you in how you should think and you can talk to the lecturer, and you can see how other students are approaching the same case that you all have. Unlike the SOAP and the [group-led] case presentations when we don't all have the same case, so you are not always sure how you would approach it (P4:2015:Post-INT)*

The 10 minutes that you get to do the case on your own, helped me see where I stand in terms of my pharmacology, compared to what my peers have done (P2:2015:Post-INT)

I personally preferred the second [academic support] session because you are also able to participate and play an active role, so in that way I learnt, and I actually take part and I think (P5:2015:Post-INT)

These sessions were the best. They were really helpful. They equipped us on how best to approach our SOAPs and open book tests. The morning session required listening skills and I don't have much of that but having to be in practice and look at the problem myself in the afternoon was the best and I loved it (P4:2015)

The few negative responses received related to a self-perceived lack of need for the academic support (two students) and the late timing of the academic support sessions, as this participant complained:

It was very helpful and should have been done much earlier in this way. You can't wait for students to fail and then implement change. It allowed us to apply our knowledge and to focus (P15:2015)

Triangulation of the qualitative results with the quantitative data supported the positive feedback received from the experimental cohort, in some respects. The student-identified need for the intervention was understandable in light of the finding that the predominant learning style in the study sample was that of Kolb's assimilator (45.40%, *n* = 163), who by the very nature of the learning style, would feel unsettled by the lack of structure and organisation in the clinical setting, as this participant explained.

As part of my personality type, I strive to live structured and I handle things in a structured manner. If I'm given steps or instructions to follow I cope much better (P30:2015)

The active learning strategies incorporated in the design of the intervention led to a significant increase (p = .012) in the ZCL4Exp students' preference for active experimentation with a decreased desire for reflective observation when processing knowledge (Paired t-test: t-value = -2.06, Cohen's d = 0.26) (Table 5.27). In addition, context-learning in the form of real patient cases, with immediate feedback on patient case analysis at the end of the session would have prompted reflection and self-assessment, which has been shown to encourage deep rather than superficial learning approaches (Tsingos et al., 2015).

An overwhelming majority of the students from ZCL4Exp (91.0%, n = 104) identified that the academic support sessions assisted in the development of case analysis skills, while 6.7% (n = 104) specifically mentioned enhanced decision making ability. However, the student-perceived improvement identified in the Post-Intervention Feedback questionnaire and post-intervention focus group was only linked to a small increase in academic achievement, with a statistically but not practically significant difference (p = .030) observed in the mean Pharmacology4 summative assessment mark between the ZCL4Comp (n = 69) and ZCL4Exp groups (n = 103) (Student's t-test, t-value = -2.20, n = 172, Cohen's d = 0.34)

The student-perceived improvement became more apparent when the rate of academic progression was considered, as the academically weaker students in ZCL4Exp were found to have benefitted from the intervention. In the ZCL4Exp cohort, the two sub-groups of students (normal rate of progression versus slower rate) were found to obtain similar mean Pharmacology4 summative assessment marks (ZCL4Exp: normal rate of progression: 52.06±15.48% versus slower rate of progression: 51.00±14.41%; Student's t-test: t-value = 0.34, n = 102, p = .731). This was in contrast to the ZCL4Comp group,

where a practically significant difference (p = .025, Cohen's d = 0.56) was found in the mean Pharmacology4 summative assessment marks between the two sub-groups (ZCL4Comp: normal rate of progression, 50.06%±13.90 versus slower rate of progression, 41.86%±15.73 respectively; Student's t-test: t-value = 2.29, n = 69).

Thus, in conclusion, based on evidence provided by qualitative and quantitative data, the intervention was deemed to be successful.

7.2.3 Predictors of academic achievement in the ELP

7.2.3.1 Academic achievement

The APS as an indicator of pre-university academic achievement was found to be a significant predictor of academic achievement in the ELP (based on Pearson's correlation*:* r = .348, n =158, p < .001).

Academic achievement in the BPharm programme (using the weighted average for all modules at the specific academic year level) was found to be a significant predictor of academic achievement in the ELP, with the BPharm3 weighted average having the highest correlation (Pearson's correlation: BPharm1: r = .223, n = 171; p = .003; BPharm2: r = .278, n = 170, p < .001: BPharm3: r = .354, n = 172, p < .001).

Academic achievement in the discipline of pharmacology was also found to be a significant predictor of academic achievement in the ELP, with the Pharmacology2 summative assessment mark displaying a stronger association (Pharmacology2: r = .280, n = 173, p < .001; Pharmacology3: r = .267, n = 173, p < .001). However, the relationship between the Pharmacology2 and Pharmacology3 assessment marks and the ELP was weaker than the relationship observed between the BPharm3 weighted average and academic achievement in ELP.

Thus, although a significant relationship between academic achievement in the ELP and Pharmacology2 and Pharmacology3 existed, pharmacology was found to be a weak predictor of academic success in the ELP when compared to the weighted average of the modules at the third year level of the BPharm programme.

The admission route into the BPharm programme was not found to be a predictor of academic achievement in the ELP, with no significant difference (p = .409) observed in the mean Pharmacology4 summative assessment marks (four year BPharm programme versus five year Extended BPharm programme: Student's t-test, t-value = 0.83, n = 172).

However, the rate of academic progression was found to influence academic achievement in the ELP, with significant differences were observed in the mean Pharmacology4 summative assessment marks when the rate of academic progression was categorised into: minimum time period; one additional year; two additional years; and three or more additional years (ANOVA, F = 3.62, p = .014).

7.2.3.2 Influence of language

The multicultural nature of the student population at NMMU was clearly illustrated by the diversity of languages (23 in total) identified as mother tongue by the study sample. This needs to be viewed in light of NMMU's language policy, where English is the official medium for both teaching and assessment. Only a third of the study sample (37.37%; n = 172) indicated English as the mother tongue language. As would be expected, the EFL students from both cohorts obtained significantly higher scores for English reading comprehension skills (p = .004, Student's t-test, t-value = -2.95, n = 163, Cohen's d = 0.48). However, no difference was seen in the mean Pharmacology4 marks obtained by EFL and ESL groups, suggesting that mother tongue did not influence academic achievement in the ELP (p = .430, Student's t-test, t-value = -0.79, n = 171).

Of concern was the finding that only 19.53% of the study sample (n = 169) were categorised as *proficient* in terms of reading comprehension skills, with the majority of students falling into the *functional* category (58.58%), and a further 21.89% categorised as *developing* or *expanding* (which suggests that these students are potentially at risk academically).

There was a significant correlation between scores for English Comprehension Reading ability and the marks obtained in the final Pharmacology4 November examination in the combined cohorts (Pre-ELP: Pearson's correlation: r = .356, n = 164, p < .001) with significant differences noted in Pharmacology4 marks obtained by students when grouped according to the four categories of English reading comprehension ability (ANOVA, F = 9.28, n = 164, p < .001). English reading comprehension ability was therefore found to be a predictor of academic achievement in the ELP.

7.2.3.3 Influence of learning styles

Pre- and post-ELP, the predominant learning style, using Kolb's LSI, was found to be that of assimilator (45.40%, n = 163) in both comparator and experimental cohorts, while the second largest group was that of converger (26.99%, n = 163).

A shift away from reflection, towards active experimentation as the preferred approach to processing information was observed post-ELP in both cohorts, with a significant difference observed for the ZCL4Exp group between the pre- and post-ELP mean test scores on the *active-reflective* (AE-RO) axis (Paired t-test: t-value = -2.06, p = .012, Cohen's d = 0.26). The shift was also seen in the re-distribution of learning style preferences post-ELP, with an increased percentage of convergers noted in both cohorts (34.59%, n = 159). Thus, the ELP appeared to modify learning styles as demonstrated by

the increased number of convergers in both cohorts post-ELP and the intervention resulted in a significant shift towards active experimentation in the ZCL4Exp group.

No significant difference was observed in the mean Pharmacology4 summative assessment marks, pre- or post-ELP, when students were grouped into the four learning styles (ZCL4Comp: pre-ELP: ANOVA, $F = 2.13$, $n = 65$, $p = .106$; post-ELP: ANOVA, $F = 1.18$, $n = 59$, $p = .327$; ZCL4Exp: pre-ELP: ANOVA, $F = 1.87$, $n = 92$, $p = .141$; post-ELP: ANOVA, $F = 2.08$, $n = 95$, $p = .109$). Thus no relationship could be established between learning styles and academic achievement in the ELP.

7.2.3.4 Influence of problem solving ability

Comparison of Raven's SPM pre-ELP mean total test scores confirmed that students in the comparator and experimental groups were similar in terms of intellectual ability. There was no significant change in the mean Raven's SPM total test scores obtained in the experimental cohort over the duration of the ELP, implying that no change in problem solving ability as a result of the intervention (ZCL4Exp: Pre-ELP vs Post-ELP: paired *t*-test: *t* - value = 0.58, $n = 81$, $p = .566$). Findings in the published literature suggest that the period over which the pre- and post- test scores were measured may have been too short to detect changes in higher order cognitive functioning, as these changes characteristically occur slowly (Niu et al., 2013).

A significant ($p < .001$), positive, moderate correlation was observed between pre-ELP Raven's SPM total test scores and academic achievement in the ELP for the combined two cohorts (Pearson's correlation: $r = .300$, $n = 174$), which confirmed an association between problem solving ability and academic success in the ELP. The strength of the relationship was found to increase post-ELP, with a significant ($p < .001$), positive, moderate correlation observed (Pearson's correlation: $r = .338$, $n = 146$). Student feedback

confirmed the strengthening of the association, with numerous descriptions of self-reported improvements in problem solving skills over the course of the ELP, both in the context of the intervention, and the hospital-based ELP. Thus Raven's SPM was found to be a predictor of academic achievement in the ELP, although the SPM may not have been sensitive enough to detect changes in problem solving ability over the relatively short duration of the ELP.

7.2.3.5 Preparing for the ELP - the influence of previous pharmacy-based work experience

Prior to the ELP, few students had prior work experience in a hospital setting (30.64%, n = 173), with the majority of work experience occurring in the community pharmacy setting. Most of the students reported involvement in direct patient care activities such as the provision of dispensed medicine, patient counselling and pharmacist-initiated therapy at the OTC level, although the extent to which this occurred varied considerably. A few students identified that community pharmacy provided invaluable experience in working under pressure, multi-tasking and communicating with patients and other healthcare professionals.

However, the students' experience of the pharmacy-based work experience differed. Of concern were the reports from some students that involvement in direct patient care activities occurred at a "seldom" or "occasional" frequency. This information collaborated with qualitative data which described a lack of patient-focused activities during the externship hours, and a perception that community pharmacy did not adequately prepare students for the ELP due to the fact that opportunities to apply and integrate pharmacology were not encountered. In addition, the majority of students from both cohorts highlighted a lack of interaction with medical doctors or prescribers prior to the

ELP. Feelings of insubordination and inferiority were also expressed by students in communications with medical doctors.

Thus, as illustrated, previous work experience in a pharmacy environment prior to the ELP, was found in some instances to prepare students for the ELP, although differences were encountered in the quality and nature of the work experience which in turn impacted on the level of self- perceived preparation.

7.2.3.6 Preparing for the ELP - the extent to which application-based questions are included in Pharmacology2 and Pharmacology3 summative assessment papers

The retrospective review provided evidence of questions in all four pharmacology summative assessment papers that required application of knowledge, both at the Pharmacology2 and Pharmacology3 levels. Of concern was the variation in the content of the Pharmacology3 papers in that questions devoted to application and analysis made up 40.8% in 2013 Pharmacology3 paper but only 31% of the 2014 Pharmacology3 paper. The percentage of application-based questions increased from Pharmacology2 to Pharmacology3.

However, there was a noticeable change in the level of difficulty of the questions used in Pharmacology4 when compared to Pharmacology3 assessment papers, and this observation was substantiated by numerous appeals from the study participants for more exposure and practice, and earlier introduction to the open book format of assessment. Thus, although evidence was provided of the introduction of application-based questions in Pharmacology2, the level of difficulty of the Pharmacology4 assessment papers would justify supplementary academic support sessions in order to develop the higher order cognitive thinking skills required by the students for the problem solving and patient case analysis required in the clinical setting as well in the Pharmacology4 assessments.

7.3 CONCLUSIONS

The following conclusions may, therefore, be drawn from the results presented in Chapters Four, Five and discussed in Chapter Six.

7.3.1 Research Sub-question One

Sub-question One enquired "To what extent does academic achievement in Pharmacology, and in the BPharm programme, predict academic achievement in the ELP?" Significant, positive correlations were found between the BPharm1, BPharm2 and BPharm3 weighted averages and academic achievement in the ELP, with the strongest predictor identified to be the BPharm3 weighted average (Pearson's correlation: BPharm1: $r = .223$, $n = 171$; $p = .003$; BPharm2: $r = .278$, $n = 170$, $p < .001$: BPharm3: $r = .354$, $n = 172$, $p < .001$). Similarly, there was a weak but still significant positive correlation between Pharmacology2, and Pharmacology3, and academic achievement in the ELP (Pharmacology2: $r = .280$, $n = 173$, $p < .001$; Pharmacology3: $r = .267$, $n = 173$, $p < .001$). Thus, achievement in BPharm3 was found to be the better predictor of academic achievement in the ELP.

7.3.2 Research Sub-question Two

Sub-question Two asked "To what extent does the Admission Points Score (APS), the BPharm admission route and the rate of academic progression through the BPharm programme, predict academic achievement in the ELP?"

The APS, as a measure of academic achievement on entry to the BPharm, was found to significantly correlate with the BPharm weighted averages for the first three years of the BPharm programme (Pearson's correlation:BPharm1: $r = 0.328$, $n = 155$, $p < .001$; BPharm2: $r = 0.367$, $n = 154$, $p < .001$; BPharm3: $r = .331$, $n = 156$, $p < .001$). A significant

association was also observed between APS and the pharmacology summative assessment marks (Pearson's correlation: Pharmacology2: r = 0.317, n = 156, p < .001; Pharmacology3: r = .236, n = 156, p < .001). Lastly, a significant correlation was also observed between APS and academic achievement in the ELP (Pharmacology4 summative assessment mark) (Pearson's correlation: r = .348, n =158, p < .001). Thus the APS was identified as a predictor for academic achievement in the ELP.

No significant difference was found in the mean Pharmacology4 summative assessment marks, when the BPharm admission route was considered, thus the admission route into the BPharm programme (four year or five year Extended programme), was not found to be a predictor of academic success in the ELP (four year BPharm programme versus five year Extended BPharm programme: Student's t-test, t-value = 0.83, n = 172, p = .409).

With respect to academic progression, only 59.30% of participants (n = 172) reached the final year of the BPharm programme within the minimum time period (i.e. within 3 years for the BPharm programme, and within four years for the Extended BPharm programme). Significant differences were noted in academic achievement in the ELP when the rate of academic progression was considered, with significantly lower Pharmacology4 summative assessment marks observed in students progressing at a rate that was 3 or more years over the minimum period (ANOVA, F = 3.62, p = .014). The finding suggests that a slow rate of academic progression is associated with poor academic outcomes in the ELP, and thus the rate of academic progression could be used to predict academic achievement in the ELP.

7.3.3 Research Sub-question Three

Sub-question Three asked "How do factors such as English reading comprehension, previous work based experience in a pharmacy environment, learning styles and problem solving ability, influence academic achievement in the ELP?"

In terms of language**,** English reading comprehension ability showed a significant positive correlation with academic achievement in the ELP (Pre-ELP: Pearson's correlation: $r = .356$, $n = 164$, $p < .001$), while significant differences were found in the Pharmacology4 summative assessment marks obtained by students when grouped according to the four categories of reading comprehension ability (ANOVA, $F = 9.28$, $n = 164$, $p < .001$). Only a third of the study sample (37.37%; $n = 172$) indicated English as the mother tongue language (i.e. EFL). However, mother tongue was not found to influence achievement in Pharmacology4 as no difference was seen in the mean Pharmacology4 marks obtained by EFL and ESL groups ($p = .430$, Student's *t*-test, *t*-value = -0.79, $n = 171$). Only 19.53% of students in the combined cohorts (n = 169) were found to be in the desired category of *proficient* in terms of English reading comprehension ability.

Pharmacy work experience prior to the ELP was in some cases, found to positively prepare students for patient interaction and inter-professional communication. However, a perceived lack of opportunities to apply and integrate pharmacological knowledge in the community pharmacy setting was highlighted by many students.

No relationship was observed between students' learning styles and academic achievement in the ELP. Assimilator was found to be the dominant learning style in both comparator and experimental cohorts (45.40%: $n = 163$). However, a significant shift towards active experimentation was noted in the experimental cohort post-intervention,

observed when comparing pre- and post-ELP test scores on the *active-reflective* (AE-RO) axis (Paired *t*-test: *t*-value = -2.06, $n = 94$, $p = .012$, Cohen's $d = 0.26$). This shift could have been a result of exposure to the intervention as no such effect was observed in the comparator group.

While no significant change in problem solving ability (measured by Raven's SPM) was noted as a result of the intervention, a significant positive correlation was observed between the pre-ELP Raven's SPM total test scores and academic achievement in the ELP (Pearson's correlation: $r = .300$, $n = 175$, $p < .001$), which confirmed an association between problem solving ability and academic success in the ELP. The strength of the relationship was found to increase post-ELP, with a significant ($p < .001$), positive, moderate correlation observed (Pearson's correlation: $r = .338$, $n = 152$).

7.3.4 Research Sub-question Four

Sub-question Four enquired, "Do the assessment methods used in summative pharmacology examinations in the preceding academic years prepare pharmacy students for clinical case-based assessments, which require application of knowledge through problem solving and clinical decision making?"

Pharmacology2 and Pharmacology3 summative assessment papers were found to contain questions that required application of knowledge, although the percentage varied per paper. The Pharmacology3 assessment papers had a higher percentage of questions that involved application of knowledge or analysis (i.e. higher order cognitive domains of Bloom's taxonomy) than Pharmacology2 assessment papers. However, the level of difficulty increased substantially from Pharmacology3, to Pharmacology4, justifying the students' appeals for more practice at the open book, case study-based format of

assessment, which was categorised at the highest cognitive domain of synthesis / evaluation.

7.3.5 Research Sub-question Five

Sub-question Five explored the question, "What are the students' experiences of the experiential learning programme?" Descriptions of the students' lived experience of the ELP provided rich and in-depth details of both the positive and negative aspects of the ELP. The negative aspects were further explored in order to gain a better insight into the nature and extent of difficulties experienced by the Pharmacology4 students. The resultant discussions guided the development of the intervention.

7.3.6 Research Sub-question Six

Sub-question Six asked "To what extent could supplementary academic support influence academic achievement in the ELP?" The success of the intervention was evident from the qualitative data obtained from the post-intervention feedback questionnaire and post-intervention focus group, with overwhelmingly positive feedback from the majority of the experimental cohort (91.0%, $n = 104$) identifying that the academic support sessions enhanced the development of case analysis skills.

The student-reported improvement in case analysis skills was linked to a small increase in academic achievement in the ELP, with a statistically but not practically significant difference ($p = .030$) observed in the mean Pharmacology4 summative assessment mark between the ZCL4Comp ($n = 69$) and ZCL4Exp groups ($n = 103$) (Student's t-test, t-value = -2.20, $n = 172$, Cohen's $d = 0.34$). The academically weaker students in ZCL4Exp were found to have benefitted from the intervention, evidenced by the similarity in the mean Pharmacology4 summative assessment marks obtained by the

two sub-groups of students (normal rate of progression versus slower rate) (ZCL4Exp: normal rate of progression: 52.06±15.48% versus slower rate of progression: 51.00±14.41%; Student's *t*-test: *t*-value = 0.34, $n = 102$, $p = .731$). Thus the supplementary academic support sessions were found to influence academic achievement in the ELP.

7.4 LIMITATIONS OF THE RESEARCH

One of the limitations of the research was that the data obtained was limited to final year BPharm students from one university in one province of South Africa, which limits the generalisation of the findings. Purposive sampling was employed as the study sample consisted of students registered for the first time for the Pharmacology4 module. The sample sizes were deemed adequate for statistical analysis after consultation with a statistician, with a maximum of 70 students participating in Phase One and 106 participants in Phase Two, which allowed small discrepancies to be accounted for.

A second limitation was the voluntary nature of the pre- and post-ELP testing, which on occasion, may have yielded suboptimal results from unmotivated or uninterested students. Obvious anomalies in the results were highlighted in the discussions but were not excluded from the findings.

The small sample sizes used in the focus groups could be viewed as a limitation. However, in qualitative research using focus groups, the sample size is typically limited to a few individuals, and sampling of data continues until saturation is reached (Krueger & Casey, 2009). The use of questionnaire-based surveys in the form of the Pharmacology4 Module Feedback questionnaire and Post-Intervention Feedback questionnaire, which were group-administered to the cohorts, and then followed up with the focus groups, achieved data saturation in the current research, as no new ideas emerged by the end of the

focus groups, and more than one focus group session was held to explore the relevant topics.

7.5 RECOMMENDATIONS FOR FURTHER RESEARCH

The findings of the current research have described the lived experiences of final year pharmacy students prior to and on completion of a hospital-based ELP in a South African setting. Little to no research has been conducted from this perspective in South Africa, and the insight gained was instrumental in the design of an intervention using clinical case-based, academic support sessions, delivered using a variety of active learning strategies. Several factors were identified which influenced academic achievement in the ELP, while further investigation is indicated in the following areas:-

- Research into student learning with respect to the approaches used when learning pharmacology, in order to develop teaching and learning strategies to foster deep learning;
- Identify an appropriate measure for tracking the development of problem solving and critical thinking skills across the four years of the BPharm curriculum;
- Early introduction of a introductory hospital-based ELP in order to familiarise students with the clinical environment, prior to commencement of the ELP in final year of the BPharm programme;
- Research into English language development strategies within the BPharm curriculum in order to support and develop ESL students;
- Introduce inter-professional teamwork in undergraduate pharmacy education as a means of fostering communication and better understanding of the role of each team player in the healthcare setting.

7.6 RELEVANCE OF THE RESEARCH FINDINGS

The study sample at NMMU can be considered to be representative of students enrolled for undergraduate pharmacy degrees at other universities, both in South Africa and internationally, and thus, the findings should be of wider interest and relevance. The difficulties experienced in the application and integration of knowledge are not unique to pharmacy students, and thus, educators involved in ELP's for other healthcare professionals should find aspects of the research to be of relevance. As pharmacy educators in developed and developing countries move towards increased experiential learning in undergraduate pharmacy programmes, the findings of the current research provide insight into the difficulties experienced by the students during the transition from didactic, lecture-based learning to experiential learning in patient-focused environments. In addition, potential solutions are described in order to provide students with academic support during the transition.

BIBLIOGRAPHY

AACP. (2016). Pharmacy school admission requirements: individual school information. *American Association of Colleges of Pharmacy.* Retrieved from http://www.aacp.org/resources/student/pharmacyforyou/admissions/Pages/default.aspx

Abbas, M., Burrow, J., & Rudokas, M. (2013). An evaluation of the placement scheme on the MPharm degree. *Diffusion-The UCLan Journal of Undergraduate Research, 6*(2), 1-14.

Ackman, M. L., & Mysak, T. M. (2009). Structuring an early clinical experience for pharmacy students: lessons learned from the hospital perspective. *The Canadian Journal of Hospital Pharmacy, 62*(4), 320-325.

ACPE. (2010). Simulations for introductory pharmacy practice experiences *Accreditation Council for Pharmacy Education: Policies and procedures for ACPE accreditation of professional degree programs.* Retrieved from http://www.acpe-accredit.org/pdf/cs_policiesandprocedures.pdf

ACPE. (2015). Guidance for accreditation standards and key elements for the professional program in pharmacy leading to the Doctor of Pharmacy degree. *Accreditation Council for Pharmacy Education: Guidance for Standards 2016.* Retrieved from https://www.acpe-accredit.org/pdf/GuidanceforStandards2016FINAL.pdf

Adamcik, B., Hurley, S., & Erramouspe, J. (1996). Assessment of pharmacy students' critical thinking and problem-solving abilities. *American Journal of Pharmaceutical Education, 60,* 256-265.

AFPC. (2010). Position statement and joint resolution on the Doctor of Pharmacy (PharmD) for the first professional degree at universities in Canada. *Association of Faculties of Pharmacy of Canada.* Retrieved from https://www.afpc.info/sites/default/files/AFPC_ADPC_PharmD_Position_Statement_Resolution_Sept_2010.pdf

Allen, D., & Bond, C. (2001). Prepharmacy predictors of success in pharmacy school: grade point averages, pharmacy college admissions test, communication abilities, and critical thinking skills. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 21*(7), 842-849.

Alrakaf, S., Anderson, C., Coulman, S. A., John, D. N., Tordoff, J., Sainsbury, E., . . . Smith, L. (2015). An International Comparison Study of Pharmacy Students' Achievement Goals and their Relationship to Assessment Type and Scores. *American Journal of Pharmaceutical Education, 79*(3), Article 35.

Anderson, C. (2010). Presenting and evaluating qualitative research. *American Journal of Pharmaceutical Education, 74*(8), Article 141.

Anderson, C., Bates, I., Beck, D., Brock, T. P., Futter, B., Mercer, H., . . . Yonemura, A. (2009). The WHO UNESCO FIP Pharmacy Education Taskforce. *Human Resources for Health, 7*(1), 45-53.

Anderson, C., Bates, I., Brock, T., Brown, A. N., Bruno, A., Futter, B., . . . Rouse, M. J. (2012). Needs-based education in the context of globalization. *American Journal of Pharmaceutical Education, 76*(4), Aricle 56.

Anderson, C., Bates, I., Bruno, A., Futter, B., Rouse, M., & Whitmarsh, S. (2009). *2009 FIP Global Pharmacy Workforce Report*. Retrieved from The Hague: Netherlands www.fip.org/hr.Wuliji T

Anderson, C., & Futter, B. (2009). PharmD or needs based education: which comes first? *American Journal of Pharmaceutical Education, 73*(5).

Anderson, L., & Krathwohl, D. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

APC. (2012). Accreditation Standards for Pharmacy Programs in Australia and New Zealand. *Australian Pharmacy Council.* Retrieved from https://www.pharmacycouncil.org.au/media/1032/accreditation-standards-pharmacy-programs-aunz-2014.pdf

Austin, Z. (2004a). Development and Validation of the Pharmacists' Inventory of Learning Styles (PILS). *American Journal of Pharmaceutical Education, 68*(2), Article 37.

Austin, Z. (2004b). Learning Styles of Pharmacists: Impact on Career Decisions, Practice Patterns and Teaching Method Preferences. *Pharmacy Education, 4*(1), 13-22.

Austin, Z., & Ensom, M. H. (2008). Education of pharmacists in Canada. *American Journal of Pharmaceutical Education, 72*(6), Article 128.

Babar, Z.-U.-D., Scahill, S. L., Akhlaq, M., & Garg, S. (2013). A bibliometric review of pharmacy education literature in the context of low-to middle-income countries. *Currents in Pharmacy Teaching and Learning, 5*(3), 218-232.

Babbie, E. (2010). *The practice of social research*. Belmont, California: Wadsworth.

Basak, S. C., & Sathyanarayana, D. (2010). Pharmacy education in India. *American Journal of Pharmaceutical Education, 74*(4), 1-9.

Battistella, M., Seki, J., Wong, G., Arora, V., & Musing, E. (2004). Development and evaluation of a student early hospital exposure program in a Canadian Bachelor of Science Pharmacy program. *American Journal of Pharmaceutical Education, 68*(4), Article 102.

Beatty, S. J., Kelley, K. A., Metzger, A. H., Bellebaum, K. L., & McAuley, J. W. (2009). Team-based learning in therapeutics workshop sessions. *American Journal of Pharmaceutical Education, 73*(6), Article 100.

Belmont Report. (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research: Report of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research*. Washington, D.C.: US Government Printing Office.

Beyea, S. C., & Nicoll, L. H. (2000). Methods to conduct focus groups and the moderator's role. *AORN journal, 71*(5), 1067-1068.

Beyer, B. K. (1987). *Practical strategies for the teaching of thinking*. Boston, Massachusetts: Allyn & Bacon.

Bharuthram, S. (2012). Making a case for the teaching of reading across the curriculum in higher education. *South African Journal of Education, 32*(2), 205-214.

Biesta, G. (Ed.) (2010). *Pragmatism and the philosophical foundations of mixed methods research* (2 ed.). Thousand Oaks, California: Sage Publications.

Bilal, A. I., Tilahun, Z., Beedemariam, G., Ayalneh, B., & Hailemeskel, B. (2016). Attitude and satisfaction of health care providers towards clinical pharmacy services in Ethiopia: A post-deployment survey. *Journal of Pharmaceutical Policy and Practice, 9*(7), 14.

Bissessur, S. W., Geijteman, E. C., Al Dulaimy, M., Teunissen, P., Richir, M. C., Arnold, A. E., & De Vries, T. P. (2009). Therapeutic reasoning: from hiatus to hypothetical model. *Journal of evaluation in clinical practice, 15*(6), 985-989.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive Domain*. New York: McKay.

Blouin, R. A., Joyner, P. U., & Pollack, G. M. (2008). Preparing for a renaissance in pharmacy education: the need, opportunity, and capacity for change. *American Journal of Pharmaceutical Education, 72*(2), 42-45.

Boschmans, S.-A. (2013). *Teaching pharmacology: issues of language and learning in a multilingual classroom setting.* (DPhil (Education) Doctoral), Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.

Boschmans, S.-A., & Kairuz, T. (2009). Undergraduate pharmacy education in two countries in the southern hemisphere. *Pharmacy Education, 9*(1), 44-49.

Boschmans, S.-A., & Webb, P. (2014). Evaluating the relationship between general health vocabulary and student achievement in pharmacology. *American Journal of Pharmaceutical Education, 78*(6), Artlcle 122.

Bowling, A. (2011). *Research Methods in Health* (3 ed.). Berkshire, England: Open University Press, McGraw-Hill Education.

Boyle, C. J., Beardsley, R. S., Morgan, J. A., & Rodriguez de Bittner, M. (2007). Professionalism: a determining factor in experiential learning. *American Journal of Pharmaceutical Education, 71*(2), Article 31.

Boyle, C. J., Morgan, J. A., Layson-Wolf, C., & De Bittner, M. R. (2009). Developing and implementing an Academy of Preceptors. *American Journal of Pharmaceutical Education, 73*(2), Article 34.

Brackett, C. C., & Reuning, R. H. (1999). Teaching pharmacokinetics using a student-centered, modified mastery-based approach. *American Journal of Pharmaceutical Education, 63*(3), 272-277.

Bronstein, L. R., & Kovacs, P. J. (2013). Writing a mixed methods report in social work research. *Research on Social Work Practice, 23*(3), 354-360.

Brouwers, S. A., Van de Vijver, F. J., & Van Hemert, D. A. (2009). Variation in Raven's Progressive Matrices scores across time and place. *Learning and Individual Differences, 19*(3), 330-338.

Bryman, A. (1988). *Quantity and Quality in Social Research*. London: Allen & Unwin.

Burke, J. M., Miller, W. A., Spencer, A. P., Crank, C. W., Adkins, L., Bertch, K. E., . . . Valley, A. W. (2008). Clinical pharmacist competencies. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 28*(6), 806-815.

Buschkuehl, M., & Jaeggi, S. M. (2010). Improving intelligence: A literature review. *Swiss medical weekly, 140*(19-20), 266-272.

Bush, T., & Glover, D. (2016). School leadership and management in South Africa: findings from a systematic literature review. *International Journal of Educational Management, 30*(2), 211-231.

Carpenter, P. A., Just, M. A., & Shell, P. (1990). What one intelligence test measures: a theoretical account of the processing in the Raven Progressive Matrices Test. *Psychological review, 97*(3), 404-431.

Carroll, C. A., & Garavalia, L. S. (2004). Factors contributing to the academic achievement of pharmacy students: Use of the Goal-Efficacy Framework. *American Journal of Pharmaceutical Education, 68*(4), Article 88.

Caruth, G. D. (2013). Demystifying mixed methods research design: A review of the literature. *Mevlana International Journal of Education, 3*(2), 112-122.

Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. *Educational psychology, 24*(4), 419-444.

Chaar, B. B., Brien, J.-A., Hanrahan, J., McLachlan, A., Penm, J., & Pont, L. (2011). Experimental education in Australian pharmacy: preceptors' perspectives. *Pharmacy Education, 11*(1), 166-171.

Chalmers, R. K., Adler, D. S., Haddad, A. M., Hoffman, S., Johnson, K. A., & Woodard, J. M. (1995). The essential linkage of professional socialization and pharmaceutical care. *American Journal of Pharmaceutical Education, 59*(1), 85-90.

Charlin, B., Tardif, J., & Boshuizen, H. P. (2000). Scripts and medical diagnostic knowledge: theory and applications for clinical reasoning instruction and research. *Academic Medicine, 75*(2), 182-190.

Charupatanapong, N., McCormick, W. C., & Rascati, K. L. (1994). Predicting academic performance of pharmacy students: demographic comparisons. *American Journal of Pharmaceutical Education, 58*(3), 262-268.

Chase, P. (2007). Rethinking experiential education (or does anyone want a pharmacy student?). *American Journal of Pharmaceutical Education, 71*(2), 27-30.

Chilisa, B., & Kawulich, B. (2012). Selecting a research approach: paradigm, methodology and methods. In C. Wagner, B. Kawulich, & M. Garner (Eds.), *Doing Social Research: a global context* (1 ed.). England: McGraw-Hill Higher Education.

Chisholm, M. A. (2001). Students performance throughout the professional curriculum and the influence of achieving a prior degree. *American Journal of Pharmaceutical Education, 65*, 350-354.

Chisholm, M. A., Cobb, H. H., & Kotzan, J. A. (1995). Significant factors for predicting academic success of first-year pharmacy students. *American Journal of Pharmaceutical Education, 59*(4), 364-370.

Cisneros, R. M. (2009). Assessment of critical thinking in pharmacy students. *American Journal of Pharmaceutical Education, 73*(4), Article 66.

Cisneros, R. M., Salisbury-Glennon, J. D., & Anderson-Harper, H. M. (2002). Status of problem-based learning research in pharmacy education: a call for future research. *American Journal of Pharmaceutical Education, 66*(1), 19-26.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). *Learning styles and pedagogy in post-16 learning: A systematic and critical review* Retrieved from http://sxills.nl/lerenlerennu/bronnen/Learning%20styles%20by%20Coffield%20e.a..pdf

Cooper, L.-A., Vellurattil, R. P., & Quinones-Boex, A. (2014). Pharmacy students' perceptions of cultural competence encounters during practice experiences. *American Journal of Pharmaceutical Education, 78*(2), Article 31.

Cox, W. C., & McLaughlin, J. E. (2014). Association of Health Sciences Reasoning Test scores with academic and experiential performance. *American Journal of Pharmaceutical Education, 78*(4), Article 73.

CPhA. (2016). Becoming a pharmacist in Canada. *Canadian Pharmacists Association* Retrieved from http://www.pharmacists.ca/pharmacy-in-canada/becoming-a-pharmacist-in-canada/

Crawford, S. Y., Alhreish, S. K., & Popovich, N. G. (2012). Comparison of learning styles of pharmacy students and faculty members. *American Journal of Pharmaceutical Education, 76*(10), 192-192.

Creswell, J. W. (2003). *Research design. Qualitative, quantitative and mixed methods approaches*. Thousand Oaks, California: Sage Publications.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, California: Sage Publications.

Creswell, J. W. (2015). *A concise introduction to mixed methods research*. Thousand Oaks, California: Sage Publications.

Croskerry, P. (2009). A universal model of diagnostic reasoning. *Academic Medicine, 84*(8), 1022-1028.

Crow, R. T., Gaebelein, C. J., & Patel, M. (2005). Early indicators of success in a pharmacy curriculum: The role of pre-professional science and mathematics courses. *Pharmacy Education, 5*(3-4), 215-218.

Curry, L. (1983). *An Organization of Learning Styles Theory and Constructs*. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Quebec. ERIC Document Number ED235185

Curry, L. (1987). *Integrating concepts of cognitive or learning style: A review with attention to psychometric standards*. Ottawa: Canadian College of Health Service Executives.

Danielson, J., Craddick, K., Eccles, D., Kwasnik, A., & O'Sullivan, T. (2015). A qualitative analysis of common concerns about challenges facing pharmacy experiential education programs. *American Journal of Pharmaceutical Education, 79*(1), Article 06.

Danielson, J., Eccles, D., Kwasnik, A., Craddick, K., Heinz, A., & Harralson, A. (2014). Status of pharmacy practice experience education programs. *American Journal of Pharmaceutical Education, 78*(4), Article 72.

Deary, I. J., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence, 35*(1), 13-21.

Denetclaw, T. H., Young, E. W., Tiemeier, A. M., Scott, J. D., & Hartzler, M. L. (2014). Perceptions, obstacles, and solutions for offering Introductory Pharmacy Practice Experiences in the community hospital setting: A qualitative survey. *Currents in Pharmacy Teaching and Learning, 6*(5), 632-638.

Dennis, V. C., Britton, M. L., Wheeler, R. E., & Carter, S. M. (2014). Practice experiences at a single institutional practice site to improve advanced pharmacy practice examination performance. *American Journal of Pharmaceutical Education, 78*(3), Article 60.

Department of Basic Education. (2016). National Senior Certificate (NSC) Examinations. *Department of Basic Education.* Retrieved from http://www.education.gov.za/Curriculum/NationalSeniorCertificate(NSC)Examinations.aspx

Department of Pharmacy. (2014). *Practical Professional Practice (ZP403)*. Module Outline. Nelson Mandela Metropolitan University. Port Elizabeth, South Africa.

DeShon, R. P., Chan, D., & Weissbein, D. A. (1995). Verbal overshadowing effects on Raven's Advanced Progressive Matrices: Evidence for multidimensional performance determinants. *Intelligence, 21*(2), 135-155.

Devine, P. S., & Darbishire, P. L. (2015). National trends in IPPE programs at US schools of pharmacy from 2008-2013. *American Journal of Pharmaceutical Education, 79*(3), Article 39.

Dewey, J. (1938). *Education and experience*. New York: Schuster and Schuster.

Diab, P., Flack, P., Mabuza, L., & Moolman, H. (2015). Curriculum challenges faced by rural-origin health science students at South African medical schools. *African Journal of Health Professions Education, 7*(1), 51-54.

Diack, L., Gibson, K., Munro, K., & Strath, A. (2014). Experiences of supervision at practice placement sites. *Education Research International*, 1-7. doi:http://dx.doi.org/10.1155/2014/764519

Diaz-Gilbert, M. (2004). Vocabulary knowledge of pharmacy students whose first or best language is not English. *American Journal of Pharmaceutical Education, 68*(4), Article 91.

Drubin, D. G., & Kellogg, D. R. (2012). English as the universal language of science: opportunities and challenges. *Molecular biology of the cell, 23*(8), 1399-1399.

Durning, S. J., Artino, A. R., Schuwirth, L., & van der Vleuten, C. (2013). Clarifying assumptions to enhance our understanding and assessment of clinical reasoning. *Academic Medicine, 88*(4), 442-448.

Dutta, A. P., Wutoh, A. K., Williams, C., & Ofosu, J. R. (2002). Predictors of academic success at a historically black school of pharmacy. *Journal of Pharmacy Teaching, 10*(2), 1-14.

Eksteen, J., & Basson, M. (2015). Discovering the value of personality types in communication training for pharmacy students. *African Journal of Health Professions Education, 7*(1), 43-46.

Embo, M. P. C., Driessen, E., Valcke, M., & Van Der Vleuten, C. P. M. (2014). Scaffolding reflective learning in clinical practice: A comparison of two types of reflective activities. *Medical Teacher, 36*(7), 602-607. doi:10.3109/0142159x.2014.899686

Facione, N. C., Facione, P. A., & Sanchez, C. A. (1994). Critical thinking disposition as a measure of competent clinical judgment: The development of the California Critical Thinking Disposition Inventory. *Journal of Nursing Education, 33*(8), 345-350.

Fejzic, J., Henderson, A. J., Smith, N. A., & Mey, A. (2013). Community pharmacy experiential placement: Comparison of preceptor and student perspectives in an Australian postgraduate pharmacy programme. *Pharmacy Education, 13*(1), 15-21.

Felder, R. M. (2010). Are learning styles invalid? *On-Course Newsletter*, 1-7. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/LS_Validity (On-Course).pdf

Fern, E. F. (2001). *Advanced Focus Group Research*. Thousand Oaks, California: Sage Publications.

FIP. (2012). *FIP Education Initiatives: Pharmacy Education Taskforce. A Global Competency Framework*. Retrieved from The Hague, Netherlands: http://www.fip.org/files/fip/PharmacyEducation/GbCF_v1.pdf

FIP. (2014). *Quality Assurance of Pharmacy Education: the FIP Global Framework*. Retrieved from The Hague, Netherlands:

Fitzpatrick, B., Hawboldt, J., Doyle, D., & Genge, T. (2015). Alignment of learning objectives and assessments in therapeutics *American Journal of Pharmaceutical Education, 79*(1), Article 10.

Florczak, K. L. (2014). Purists need not apply the case for pragmatism in mixed methods research. *Nursing science quarterly, 27*(4), 278-282.

Flynn, J. R., & Rossi-Casé, L. (2012). IQ gains in Argentina between 1964 and 1998. *Intelligence, 40*(2), 145-150.

Foxcroft, C. D., Watson, A. S., Seymour, B. B., Davies, C. L., & McSorley, M. E. (2002). *Final report on the baseline assessment of second language English proficiency in Grade 8 to 12 learners as part of the Quality Learning Project*. Retrieved from Port Elizabeth, South Africa:

Frankel, G., Louizos, C., & Austin, Z. (2014). Canadian educational approaches for the advancement of pharmacy practice. *American Journal of Pharmaceutical Education, 78*(7), Article 143.

Gardner, S. F., & Monaghan, M. S. (1996). Comparison of learning styles between traditional and nontraditional pharmacy students in a doctor of pharmacy program. *Journal of Pharmacy Teaching, 5*, 31-40.

Garvey, M. (1984). An Assessment of Learning Styles among Pharmacy Students. *American Journal of Pharmaceutical Education, 48*(2), 134-140.

Gelaw, B., Tegegne, G., & Aynalem, G. (2016). Opportunities and challenges in the new emerging role of clinical pharmacists in Ethiopia: systematic review. *Journal of Pharmaceutical Care & Health Systems, 2016*.

Ghayur, M. N. (2008). Pharmacy education in developing countries: need for a change. *American Journal of Pharmaceutical Education, 72*(4), Article 94.

Gignac, G. E. (2015). Raven's is not a pure measure of general intelligence: Implications for g factor theory and the brief measurement of g. *Intelligence, 52*, 71-79.

Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British dental journal, 204*(6), 291-295.

Giuliano, C. A., Gortney, J., & Binienda, J. (2016). Predictors of performance on the pharmacy curriculum outcomes assessment (PCOA). *Currents in Pharmacy Teaching and Learning, 8*, 148-154.

Gleason, B. L., Gaebelein, C. J., Grice, G. R., Crannage, A. J., Weck, M. A., Hurd, P., . . . Duncan, W. (2013). Assessment of students' critical-thinking and problem-solving abilities across a 6-year doctor of pharmacy program. *American Journal of Pharmaceutical Education, 77*(8), Article 166.

Gleason, B. L., Peeters, M. J., Resman-Targoff, B. H., Karr, S., McBane, S., Kelley, K., . . . Denetclaw, T. H. (2011). An active-learning strategies primer for achieving ability-based educational outcomes. *American Journal of Pharmaceutical Education, 75*(9), Article 186.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report, 8*(4), 597-606.

Gottfredson, L. (1997). Why *g* matters: the complexity of everyday life. *Intelligence, 24*(1), 79-132.

GPhC. (2011). Future standards for the initial education and training of pharmacists. *General Pharmaceutical Council (Great Britain).* Retrieved from https://www.pharmacyregulation.org/educationstandards

GPhC. (2016). Registration as a pharmacist *General Pharmaceutical Council (Great Britain).* Retrieved from https://www.pharmacyregulation.org/registration

Green, J. (2015). The effect of English proficiency and ethnicity in academic performance and progress. *Advances in Health Sciences Education, 20,* 219-228.

Griffith, C. H., Wilson, J. F., Haist, S. A., Albritton, T. A., Bognar, B. A., Cohen, S. J., . . . Pryor, O. W. (2009). Internal medicine clerkship characteristics associated with enhanced student examination performance. *Academic Medicine, 84*(7), 895-901.

Guest, G. (2012). Describing mixed methods research An alternative to typologies. *Journal of mixed methods research, 7*(2), 141-151.

Gurpinar, E., Alimoglu, M. K., Mamakli, S., & Aktekin, M. (2010). Can learning style predict student satisfaction with different instruction methods and academic achievement in medical education? *Advances in physiology education, 34*(4), 192-196.

Gurpinar, E., Bati, H., & Tetik, C. (2011). Learning styles of medical students change in relation to time. *Advances in physiology education, 35*(3), 307-311.

Gutema, G. B., Hadera, M. G., Dagne, A. W., & Mamo, Y. A. (2011). The metamorphosis of Pharmacy education in Ethiopia: the case of Mekelle University. *International Journal of Pharmacy Teaching and Practices, 2*, 120-128.

Haase, K. K., Smythe, M. A., Orlando, P. L., Resman-Targoff, B. H., & Smith, L. S. (2008). Quality experiential education. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *28*(12), 1547-1547.

Haier, R. J., White, N. S., & Alkire, M. T. (2003). Individual differences in general intelligence correlate with brain function during nonreasoning tasks. *Intelligence, 31*(5), 429-441.

Hall, K., Musing, E., Miller, D. A., & Tisdale, J. E. (2012). Experiential training for pharmacy students: time for a new approach. *The Canadian Journal of Hospital Pharmacy, 65*(4), 285-293.

Hall, M., Hanna, L.-A., Hanna, A., & Hall, K. (2015). Associations between achievement goal orientations and academic performance among students at a UK pharmacy school. *American Journal of Pharmaceutical Education, 79*(5), Article 64.

Hamel, R., & Schmittmann, V. D. (2006). The 20-minute version as a predictor of the Raven Advanced Progressive Matrices Test. *Educational and Psychological Measurement, 66*(6), 1039-1046.

Hammer, D. (2006). Improving student professionalism during experiential learning. *American Journal of Pharmaceutical Education, 70*(3), Article 59.

Hardigan, P. C., Lai, L. L., Arneson, D., & Robeson, A. (2001). Significance of academic merit, test scores, interviews and the admissions process: case study. *American Journal of Pharmaceutical Education, 65*(1), 40-43.

Hardinger, K., Garavalia, L., Graham, M. R., Marken, P. A., Melchert, R. B., Nelson, L. A., & Stahnke, A. (2015). Enrollment management strategies in the professional pharmacy program: A focus on progression and retention. *Currents in Pharmacy Teaching and Learning, 7*(2), 199-206.

Hardinger, K., Schauner, S., Graham, M., & Garavalia, L. (2013). Admission predictors of academic dismissal for provisional and traditionally admitted students. *Currents in Pharmacy Teaching and Learning, 5*(1), 33-38.

Hasan, S. S., Wong, P. S., Ahmed, S. I., Chong, D. W. K., Mai, C. W., Pook, P., & Kairuz, T. (2013). Perceived impact of clinical placements on students' preparedness to provide patient-centered care in Malaysia. *Currents in Pharmacy Teaching and Learning, 5*(4), 303-310.

Hassell, K., Seston, E., Eden, M., & Willis, S. (2007). The UK pharmacy degree: Attrition rates and demographics of non-completers. *Pharmacy Education, 7*(3), 249-256.

Hastings, J. K., West, D. S., & Hong, S. H. (2005). Changes in pharmacy student motivation during progression through the curriculum. *American Journal of Pharmaceutical Education, 69*(2), 251-255.

Hawthorne, N., & Anderson, C. (2009). The global pharmacy workforce: a systematic review of the literature. *Human Resources for Health, 7*(1), 48. doi:10.1186/1478-4491-7-48

Heer, R. (2012). A model of learning objectives *Center for Excellence in Learning and Teaching, Iowa State University.* Retrieved from http://www.celt.iastate.edu/teaching/RevisedBlooms1. html

Ho, M.-J., Chan, E., Fan-Harvard, P., Thompson, C., & Hess, J. (2014). The effects of leadership involvement and part-time employment on pharmacy student academic performance. *Pharmacy Education, 14*(1), 57-63.

Hogan, S., & Lundquist, L. M. (2006). The impact of problem-based learning on students' perceptions of preparedness for advanced pharmacy practice experiences. *American Journal of Pharmaceutical Education, 70*(4), Article 82.

Holder, G. M., Jones, J., Robinson, R., & Krass, I. (1999). Academic literacy skills and progression rates amongst pharmacy students. *Higher Education Research & Development, 18*(1), 19-30.

Horsburgh, M., Lamdin, R., & Williamson, E. (2001). Multiprofessional learning: the attitudes of medical, nursing and pharmacy students to shared learning. *Medical Education, 35*(9), 876-883.

Houglum, J. E., Aparasu, R. R., & Delfinis, T. M. (2005). Predictors of academic success and failure in a pharmacy professional program. *American Journal of Pharmaceutical Education, 69*(3), 284-289.

Howe, K. R. (1988). Against the quantitative-qualitative incompatibility thesis or dogmas die hard. *Educational researcher, 17*(8), 10-16.

Hudson, K. (2015). Nursing student engagement: student, classroom and clinical engagement. *International Journal of Nursing, 4*(1), 44-52.

Hudson, S., McAnaw, J., & Johnson, B. (2007). The changing roles of pharmacists in society. *International e-Journal of Science, Medicine & Education, 1*(1), 22-34.

Hughes, C. M., & McCann, S. (2003). Perceived interprofessional barriers between community pharmacists and general practitioners: a qualitative assessment. *British Journal of General Practice, 53*(493), 600-606.

Itin, C. (1999). Reasserting the philosophy of experiential education as a vehicle for change in the 21st century. *Journal of Experiential Education, 22*(2), 91-98.

Jackson, L. D. (2015). Strategies pharmacy students can use to ensure success in an experiential placement. *Canadian Pharmacists Journal/Revue des Pharmaciens du Canada, 148*(6), 308-313.

Janzen, D., Fitzpatrick, K., Jensen, K., & Suveges, L. (2013). Women in pharmacy A preliminary study of the attitudes and beliefs of pharmacy students. *Canadian Pharmacists Journal/Revue des Pharmaciens du Canada, 146*(2), 109-116.

Jensen, A. R. (1998). *The g factor: The science of mental ability* (1 ed.). Westport, Connecticut: Praeger Publishers.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher, 33*(7), 14-26.

Joy, S., & Kolb, D. (2009). Are there cultural differences in learning style? *International Journal of Intercultural Relations, 33*(1), 69-85.

Kassirer, J. P. (2010). Teaching clinical reasoning: case-based and coached. *Academic Medicine, 85*(7), 1118-1124.

Kawahara, N. E., & Ethington, C. (1994). Performance on the pharmacy college admission test: an exploratory analysis. *American Journal of Pharmaceutical Education, 58*(2), 145-150.

Kayes, D. C. (2005). Internal validity and reliability of Kolb's learning style inventory version 3 (1999). *Journal of Business and Psychology, 20*(2), 249-257.

Keijsers, C. J., Brouwers, J. R., Wildt, D. J., Custers, E. J., Ten Cate, O. T. J., Hazen, A., & Jansen, P. A. (2014). A comparison of medical and pharmacy students' knowledge and skills of pharmacology and pharmacotherapy. *British Journal of Clinical Pharmacology, 78*(4), 781-788.

Kelley, K. A., Secnik, K., & Boye, M. E. (2001). An evaluation of the pharmacy college admissions test as a tool for pharmacy college admissions committees. *American Journal of Pharmaceutical Education, 65*(3), 225-230.

Kheir, N., Al Saad, D., & Al Naimi, S. (2013). Pharmaceutical care in the Arabic-speaking Middle East: literature review and country informant feedback. *Avicenna, 2*, 1-9.

Kheir, N., Zaidan, M., Younes, H., El Hajj, M., Wilbur, K., & Jewesson, P. J. (2008). Pharmacy education and practice in 13 Middle Eastern countries. *American Journal of Pharmaceutical Education, 72*(6), Article 133.

Kidd, R., & Latif, D. (2003). Traditional and novel predictors of classroom and clerkship success of pharmacy students. *American Journal of Pharmaceutical Education, 67*(4), Article 109.

Kim, M.-K., Patel, R. A., Uchizono, J. A., & Beck, L. (2012). Incorporation of Bloom's Taxonomy into multiple-choice examination questions for a pharmacotherapeutics course. *American Journal of Pharmaceutical Education*, *76*(6), Article 114.

Kirschbaum, M., Khalil, H., & Page, A. T. (2016). Clinical placements by Australian university schools of pharmacy. *Currents in Pharmacy Teaching and Learning, 8*(1), 47-51.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work:An analysis of the failure of constructivist, discovery, problem-based, experiential and inquiry based teaching. *Educational Psychologist, 41*(2), 75-86.

Kitzinger, J. (1995). Qualitative research. Introducing focus groups. *British Medical Journal, 311*, 299-302.

Kleijn, W. C., van der Ploeg, H. M., & Topman, R. M. (1994). Cognition, study habits, test anxiety, and academic performance. *Psychological reports, 75*(3), 1219-1226.

Kleinert, S. (2010). Singapore Statement: a global agreement on responsible research conduct. *The Lancet, 376*(9747), 1125-1127.

Kolb, A., & Kolb, D. (2005). Learning styles and learning spaces: enhancing experiential learning in higher education. *Academy of Management Learning and Education, 4*(2), 193-212.

Kolb, A., & Kolb, D. (2012). Experiential learning theory *Encyclopedia of the Sciences of Learning* (pp. 1215-1219): Springer.

Kolb, D. (1984). *Experiential Learning: Experience as the source of learning and development*. Englewood Cliffs, New Jersey: Prentice-Hall

Kolb, D. (1985). *Learning style inventory: Self-scoring inventory and interpretation booklet.* Boston, Massachusetts: McBer & Co.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice, 41*(4), 212-218.

Krauss, S. E. (2005). Research paradigms and meaning making: A primer. *The qualitative report, 10*(4), 758-770.

Krueger, R. (1988). *Focus groups: a practical guide for applied research*. Thousand Oaks, California: Sage Publications.

Krueger, R., & Casey, M. (2000). *Focus groups: A practical guide for applied research* (3 ed.). Thousand Oaks, California: Sage Publications.

Krueger, R., & Casey, M. (2002). Designing and conducting focus group interviews. *Social Analysis, Selected Tools and Techniques*, 4-23.

Krueger, R., & Casey, M. (2009). *Focus groups: A practical guide for applied research*: Sage.

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions* (2 ed.). Chicago: University of Chicago Press.

Kuncel, N. R., Credé, M., Thomas, L. L., & Klieger, D. M. (2005). A meta-analysis of the validity of the Pharmacy College Admission Test (PCAT) and grade predictors of pharmacy student performance. *American Journal of Pharmaceutical Education, 69*(1-5), 339-347.

Lancaster, J. W., Douglass, M. A., Gonyeau, M. J., Wong, A., Woolley, A. B., & DiVall, M. V. (2013). Providers' perceptions of student pharmacists on inpatient general medicine practice experiences. *American Journal of Pharmaceutical Education, 77*(2), Article 26.

Landin, M., & Pérez, J. (2015). Class attendance and academic achievement of pharmacy students in a European University. *Currents in Pharmacy Teaching and Learning, 7*(1), 78-83.

Langley, C., Jesson, J. K., & Wilson, K. (2010). Learning with other health professions in the United Kingdom MPharm degree: Multidisciplinary and placement education. *Pharmacy Education, 10*(1), 39-46.

Latif, D. A. (2005). Including the assessment of nontraditional factors in pharmacy school admissions. *Annals of Pharmacotherapy, 39*(4), 721-726.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge, England: Cambridge University Press.

Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & quantity, 43*(2), 265-275.

Lemon, A. (2004). Redressing school inequalities in the Eastern Cape, South Africa. *Journal of Southern African Studies, 30*(2), 269-290.

Lewin, K. (1944). The dynamics of group action. *Educational leadership, 1*(4), 195-200.

Lobb, W., Wilkin, N., McCaffrey, D., Wilson, M., & Bentley, J. (2006). The predictive utility of nontraditional test scores for first-year pharmacy student academic performance. *American Journal of Pharmaceutical Education, 70*(6), Article 128.

Long, A., Ingram, M., Pugh, W. J., Bowes, P., Haigh, S., & Moss, G. (2008). The effect of language background on teaching and learning in the Master of Pharmacy degree. *Pharmacy Education, 8*(1), 45-52.

Long, T., & Johnson, M. (2000). Rigour, reliability and validity in qualitative research. *Clinical effectiveness in nursing, 4*(1), 30-37.

Loo, R. (2004). Kolb's learning styles and learning preferences: is there a linkage? *Educational psychology, 24*(1), 99-108.

Lund, T. (2012). Combining qualitative and quantitative approaches: Some arguments for Mixed Methods Research. *Scandinavian Journal of Educational Research, 56*(2), 155-165.

Lynch, T. G., Woelfl, N. N., Steele, D. J., & Hanssen, C. S. (1998). Learning style influences student examination performance. *The American Journal of Surgery, 176*(1), 62-66.

Lynn, R., Allik, J., & Irwing, P. (2004). Sex differences on three factors identified in Raven's Standard Progressive Matrices. *Intelligence, 32*(4), 411-424.

Mackenzie, N., & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in educational research, 16*(2), 193-205.

Macpherson, K., & Owen, C. (2010). Assessment of critical thinking ability in medical students. *Assessment and Evaluation in Higher Education, 35*(1), 45-58.

Maize, D. F., Fuller, S. H., Hritcko, P. M., Matsumoto, R. R., Soltis, D. A., Taheri, R. R., & Duncan, W. (2010). A review of remediation programs in pharmacy and other health professions. *American Journal of Pharmaceutical Education, 74*(2), Article 25.

Mar, E., Barnett, M. J., Tang, T. T., Sasaki-Hill, D., Kuperberg, J. R., & Knapp, K. (2010). Impact of previous pharmacy work experience on pharmacy school academic performance. *American Journal of Pharmaceutical Education, 74*(3), Article 42.

Marriott, J., Nation, R., Roller, L., Costelloe, M., Galbraith, K., Stewart, P., & Charman, W. N. (2008). Pharmacy education in the context of Australian practice. *American Journal of Pharmaceutical Education, 72*(6), Article 131.

Marriott, J., Taylor, S., Simpson, M., Bull, R., Galbraith, K., Howarth, H., . . . Rose, M. (2005). Australian national strategy for pharmacy preceptor education and support. *Australian Journal of Rural Health, 13*(2), 83-90.

Maudsley, G. (2011). Mixing it but not mixed up: Mixed methods research in medical education (a critical narrative review). *Medical Teacher, 33*, 92-104.

Mays, N., & Pope, C. (2000). Qualitative research in health care: Assessing quality in qualitative research. *British Medical Journal, 320*, 50-52.

McCall, K. L., Allen, D. D., & Fike, D. S. (2006). Predictors of academic success in a doctor of pharmacy program. *American Journal of Pharmaceutical Education, 70*(5), Article 106.

McCall, K. L., MacLaughlin, E. J., Fike, D. S., & Ruiz, B. (2007). Preadmission predictors of PharmD graduates' performance on the NAPLEX. *American Journal of Pharmaceutical Education, 71*(1), Article 05.

McLaughlin, J. E., Cox, W. C., Williams, C. R., & Shepherd, G. (2014). Rational and experiential decision-making preferences of third-year student pharmacists. *American Journal of Pharmaceutical Education, 78*(6), Article 120.

McMillan, W. (2007). Understanding diversity as a framework for improving student throughput. *Education for Health, 20*(3), 1-6.

McMillan, W. (2015). Identity and attribution as lenses to understand the relationship between transition to university and initial academic performance. *African Journal of Health Professions Education, 7*(1), 32-38.

Meagher, D. G., Lin, A., & Stellato, C. P. (2006). A predictive validity study of the Pharmacy College Admission Test. *American Journal of Pharmaceutical Education, 70*(3), Article 53.

Meagher, D. G., Pan, T., & Perez, C. D. (2011). Predicting performance in the first-year of pharmacy school. *American Journal of Pharmaceutical Education, 75*(5), Article 81.

Mekonnen, A. B., Yesuf, E. A., Odegard, P. S., & Wega, S. S. (2013). Implementing ward based clinical pharmacy services in an Ethiopian University Hospital. *Pharmacy Practice, 11*(1), 51-57.

Mersfelder, T. L., & Bouthillier, M. J. (2012). Value of the student pharmacist to experiential practice sites: A review of the literature. *Annals of Pharmacotherapy, 46*(4), 541-548.

Mertler, C. (2012). Experimental research. In C. Wagner, B. Kawulich, & M. Garner (Eds.), *Doing social research* Berkshire, England: McGraw-Hill Education.

Miller, G. E. (1990). The assessment of clinical skills/competence/performance. *Academic Medicine, 65*(9), S63-67.

Mkony, A. C. (2012). Emergence of a university of health sciences: Health professions education in Tanzania. *Journal of Public Health Policy, 33*(1), S45-S63. doi:10.1057/jphp.2012.51

Morgan, D. L. (2007). Paradigms lost and pragmatism regained methodological implications of combining qualitative and quantitative methods. *Journal of mixed methods research, 1*(1), 48-76.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2008). Verification strategies for establishing reliability and validity in qualitative research. *International journal of qualitative methods, 1*(2), 13-22.

Mouton, N., Louw, G., & Strydom, G. (2013). Present-day dillemas and challenges of the South African tertiary system. *The International Business & Economics Research Journal (Online), 12*(3), 285.

Myers, I. B., McCaulley, M. H., Quenk, N. L., & Hammer, A. L. (1985). *MBTI manual: A guide to the development and use of the Myers-Briggs Type Indicator* (Vol. 3). Palo Alto, California: Consulting Psychologists Press

Myers, T. L., DeHart, R. M., Vuk, J., & Bursac, Z. (2013). Prior degree status of student pharmacists: Is there an association with first-year pharmacy school academic performance? *Currents in Pharmacy Teaching and Learning, 5*(5), 490-493.

NABP. (2016). North American Pharmacist Licensure Examination (NAPLEX). Retrieved from http://www.nabp.net/programs/examination/naplex

Naing, C., Yusoff, N., Nam Yeoh, P., & Pook, P. (2013). Predicting the success of MPharm graduates in the pharmacy twinning programme. *Pharmacy Education, 13*(1), 40-44.

Nation, L., & Rutter, P. (2011). Short communication piece on experiences of final year pharmacy students to clinical placements. *Journal of Health and Social Care Improvement, 2*, 1-5.

Nel, C., Dreyer, C., & Klopper, M. (2004). An analysis of reading profiles of first-year students at Potchefstroom University: a cross-sectional study and a case study. *South African Journal of Education, 24*(1), 95-103.

Niu, L., Behar-Horenstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review, 9*(0), 114-128. doi:http://dx.doi.org/10.1016/j.edurev.2012.12.002

NMMU. (2012). Health Sciences Prospectus Port Elizabeth: Nelson Mandela Metropolitan University.

NMMU. (2015). What is an extended curriculum programme? Retrieved from https://www.nmmu.ac.za/Apply/Frequently-asked-questions/Study-@-NMMU/What-is-an-extended-curriculum-programme-#FAQLink891

NMMU. (2016). Admission. Retrieved from http://www.nmmu.ac.za/Apply/Admission/How-do-I-apply

Norman, G. (2005a). Editorial -- Inverting the Pyramid. *Advances in Health Sciences Education, 10*(2), 85-88.

Norman, G. (2005b). Research in clinical reasoning: past history and current trends. *Medical Education, 39*(4), 418-427.

Novak, S., Sonalee, S., Wilson, J. P., Lawson, K. A., & Salzman, R. D. (2006). Pharmacy students' learning styles before and after a problem-based learning experience. *American Journal of Pharmaceutical Education, 70*(4), 1-8.

Nuffer, W., Gilliam, E., McDermott, M., & Turner, C. J. (2015). Sustainability of a practice-based interprofessional Introductory Pharmacy Practice Experience course. *American Journal of Pharmaceutical Education, 79*(5), Article 62.

Oderda, G. M., Zavod, R. M., Carter, J. T., Early, J. L., Joyner, P. U., Kirschenbaum, M. S., . . . Plaza, C. M. (2010). An environmental scan of the status of critical thinking and problem solving skills in Colleges / Schools of Pharmacy: report of the 2009-2010 Academic Affairs Standing Committee. *American Journal of Pharmaceutical Education, 74*(10), Article S6.

Ogaji, I. J., Kahiga, T. M., Gachuno, O. W., & Mwangi, J. W. (2016). Development of pharmacy education in Kenya Universities to date. *African Journal of Pharmacy and Pharmacology, 10*(18), 385-392.

Owen, S., & Stupans, I. (2009). Australian pharmacy programme experiential placements: comprehensive planning for assessment and evaluation. *Assessment & Evaluation in Higher Education, 34*(5), 579-594.

Owusu-Daaku, F., & Smith, F. (2007). Programme description: Health promotion in a social pharmacy course: The Ghana experience. *Pharmacy Education, 7*(2), 187-191.

Paiva, M. A., & Wilby, K. J. (2015). Validity and reliability of the Health Professionals' Inventory of Learning Styles (H-PILS) in a rural African context. *Pharmacy Education, 15*(1), 178-181.

Parmelee, D., Michaelsen, L. K., Cook, S., & Hudes, P. D. (2012). Team-based learning: A practical guide: AMEE Guide No. 65. *Medical Teacher, 34*(5), e275-e287.

Patel, V. L., Yoskowitz, N. A., & Arocha, J. F. (2009). Towards effective evaluation and reform in medical education: a cognitive and learning sciences perspective. *Advances in Health Sciences Education, 14*(5), 791-812.

Peeters, M. (2011). Cognitive development of learners in pharmacy education. *Currents in Pharmacy Teaching and Learning, 3*, 224-229.

Peeters, M. (2016). Practical significance: moving beyond statistical significance. *Currents in Pharmacy Teaching and Learning, 8*, 83-89.

Peterson, E. R., Rayner, S. G., & Armstrong, S. J. (2009). Researching the psychology of cognitive style and learning style: Is there really a future? *Learning and Individual Differences, 19*(4), 518-523.

Pham, A. (2009). Improving pharmacy students' education through enhanced experiential learning. *American Journal of Pharmaceutical Education, 73*, 56-57.

Profetto-McGrath, J. (2003). The relationship of critical thinking skills and critical thinking dispositions of baccalaureate nursing students. *Journal of advanced nursing, 43*(6), 569-577.

Pungente, M. D., Wasan, K. M., & Moffett, C. (2003). Using learning styles to evaluate first-year pharmacy students' preferences toward different activities associated with the problem-based learning approach. *American Journal of Pharmaceutical Education, 66*, 119-124.

Purdie, F., Ward, L. J., McAdie, T. M., King, N., & Drysdale, M. (2013). Are work-integrated learning (WIL) students better equipped psychologically for work post-graduation than their non-work-integrated learning peers? Some initial findings from a UK university. *Asia Pacific Journal of Co-operative Education, 14*(2), 117-125.

Rabiee, F. (2004). Focus group interview and data analysis. *Proceedings of the Nutrition Society, 63*, 655-660.

Raelin, J. A. (2000). *Work based learning: The new frontier of management development*. New Jersey: Prentice Hall Inc.

Rathbun, R. C., Hester, E. K., Arnold, L. M., Chung, A. M., Dunn, S. P., Harinstein, L. M., . . . Wilhelm, S. M. (2012). Importance of direct patient care in advanced pharmacy practice experiences. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 32*(4), 88-97.

Raven, J., Raven, J., & Court, J. (1998). *Manual for Raven's Progressive Matrices and Vocabulary Scales: Section One General Overview*. San Antonio, Texas Pearson

Raven, J., Raven, J., & Court, J. (2000). *Manual for the Raven's Progressive Matrices and Vocabulary Scales. Section 3: The Standard Progressive Matrices*. San Antonio, Texas Pearson.

Rennie, T., & Anderson, C. (2013). Oversupply and under-resourced: The global context of pharmacy education. *American Journal of Pharmaceutical Education, 77*(6), Article 111.

Renzi, S. E., Krzeminski, M. A., & Sauberan, M. M. (2007). Prepharmacy years in college and academic performance in a professional program. *American Journal of Pharmaceutical Education, 71*(4), Article 69.

Richir, M., Tichelaar, J., Geijteman, E. T., & de Vries, T. G. M. (2008). Teaching clinical pharmacology and therapeutics with an emphasis on the therapeutic reasoning of undergraduate medical students. *European journal of clinical pharmacology, 64*(2), 217-224.

Ried, L. D., & Posey, L. M. (2006). The changing face of pharmacy. *Journal of American Pharmacists Association, 46*(3), 320-321.

Roberts, P., Priest, H., & Traynor, M. (2006). Reliability and validity in research. *Nursing standard, 20*(44), 41-45.

Robles, J., Cox, C. D., & Seifert, C. F. (2012). The impact of preceptor and student learning styles on experiential performance measures. *American Journal of Pharmaceutical Education, 76*(7), Article 128.

Romanelli, F., Bird, E., & Ryan, M. (2009). Learning styles: a review of theory, application, and best practices. *American Journal of Pharmaceutical Education, 73*(1), Article 9.

Rosenthal, M., Austin, Z., & Tsuyuki, R. T. (2010). Are pharmacists the ultimate barrier to pharmacy practice change? *Canadian Pharmacists Journal, 143*(1), 37-42.

Rothmann, S., Basson, W. D., & Rothmann, J. C. (2000). Personality preferences of lecturers and students at a pharmacy school. *International Journal of Pharmacy Practice, 8*(3), 225-233.

Rudall, N., Rennie, T., Singu, B., & Kibuule, D. (2015). Mock patient cases are valid tools for assessing clinical pharmacy skills in undergraduate students. *Pharmacy Education, 15*(1), 155-158.

Rushton, J. P. (1998). The "Jensen effect" and the "Spearman-Jensen hypothesis" of Black-White IQ differences. *Intelligence, 26*(3), 217-225.

Rushton, J. P., & Jensen, A. R. (2005). Thirty years of research on race differences in cognitive ability. *Psychology, public policy, and law, 11*(2), 235-294.

Rushton, J. P., & Skuy, M. (2001). Performance on Raven's Matrices by African and White university students in South Africa. *Intelligence, 28*(4), 251-265.

Rushton, J. P., Skuy, M., & Fridjhon, P. (2002). Jensen effects among African, Indian, and White engineering students in South Africa on Raven's Standard Progressive Matrices. *Intelligence, 30*(5), 409-423.

Rushton, J. P., Skuy, M., & Fridjhon, P. (2003). Performance on Raven's Advanced Progressive Matrices by African, East Indian, and White engineering students in South Africa. *Intelligence, 31*(2), 123-137.

Sansgiry, S. S., Bhosle, M., & Sail, K. (2006). Factors that affect academic performance among pharmacy students. *American Journal of Pharmaceutical Education, 70*(5), Article 104.

Sansgiry, S. S., Kawatkar, A. A., Dutta, A. P., & Bhosle, M. J. (2004). Predictors of academic performance at two universities: the effects of academic progression. *American Journal of Pharmaceutical Education, 68*(4), Article 103.

Sansom, V. E., & Cox, E. A. (2013). Student pharmacists' perspective on actual vs. simulated pharmacy practice experiences. *Currents in Pharmacy Teaching and Learning, 5*(2), 146-148.

SAPC. (2014). *2014 Annual Report: South African Pharmacy Council Annual Reports* Retrieved from http://www.pharmcouncil.co.za/G_Publications.asp

SAPC. (2015). Training of pharmacists in South Africa. Retrieved from http://www.pharmcouncil.co.za/B_Edu_Training.asp

SAQA. (2012). South African Qualifications Authority: Bachelor of Pharmacy degree. Retrieved from http://www.saqa.org.za/show.asp?id=2783

Schank, R. C. (1977). *Scripts, plans, goals and understanding : an inquiry into human knowledge structures* Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Schauner, S., Hardinger, K. L., Graham, M. R., & Garavalia, L. (2013). Admission variables predictive of academic struggle in a PharmD program. *American Journal of Pharmaceutical Education, 77*(1), Article 8.

Schlesselman, L. S., & Coleman, C. (2011). Predictors of poor student performance at a single, accreditation Council for Pharmacy Education–accredited school of pharmacy. *Currents in Pharmacy Teaching and Learning, 3*, 101-105.

Seabi, J. (2011). Relating learning strategies, self-esteem, intellectual functioning with academic achievement among first-year engineering students. *South African Journal of Psychology, 41*(2), 239-249.

Shah, R. (2004). Improving undergraduate communication and clinical skills: personal reflections of a real world experience. *Pharmacy Education, 4*(1), 1-6.

Sharif, S., Gifford, L., Morris, G., & Barber, J. (2010). The relationship between learning styles, attendance and academic performances of pharmacy undergraduates. *Pharmacy Education, 10*(2), 138-143.

Sharif, S., Gifford, L., Morris, G. A., & Barber, J. (2003). Can we predict student success (and reduce student failure)? *Pharmacy Education, 3*(2), 77-86.

Sharif, S., Gifford, L. A., Morris, G. A., & Barber, J. (2007). Diagnostic testing of first year pharmacy students: A tool for targeted student support. *Pharmacy Education, 7*(3), 215-221.

Shuck, A. A., & Phillips, C. R. (1999). Assessing pharmacy students' learning styles and personality types: a ten-year analysis. *American Journal of Pharmaceutical Education, 63*, 27-33.

Siracuse, M., Schondelmeyer, S., Hadsall, R., & Schommer, J. (2008). Third year pharmacy students' work experience and attitudes and perceptions of the pharmacy profession. *American Journal of Pharmaceutical Education, 72*(3), Article 50.

Skrabal, M. Z., Kahaleh, A. A., Nemire, R. E., Boxer, H., Broshes, Z., Harris, M., & Cardello, E. (2006). Preceptors' perspectives on benefits of precepting student pharmacists to students, preceptors, and the profession. *Journal of the American Pharmacists Association, 46*(5), 605-612.

Skuy, M., Gewer, A., Osrin, Y., Khunou, D., Fridjhon, P., & Rushton, J. P. (2002). Effects of mediated learning experience on Raven's matrices scores of African and non-African university students in South Africa. *Intelligence, 30*(3), 221-232.

Smith, L., Greene, J., Meade, L., & Spencer, B. (2009). Qualitative analysis of students' attitudes of duration of community pharmacy practice experiences. *Currents in Pharmacy Teaching and Learning, 1*(2), 110-114.

Smith, L., Krass, I., Sainsbury, E., & Rose, G. (2010). Pharmacy students' approaches to learning in undergraduate and graduate entry programs. *American Journal of Pharmaceutical Education, 74*(6), Article 106.

Smith, T. E., & Knapp, C. E. (2010). *Sourcebook of Experiential Education: Key Thinkers and Their Contributions*. New York: Routledge.

Sosabowski, M. H., & Gard, P. R. (2008). Pharmacy education in the United Kingdom. *American Journal of Pharmaceutical Education, 72*(6), Article 130.

Spearman, C. (1904). " General Intelligence," objectively determined and measured. *The American Journal of Psychology*, *15*(2), 201-292.

Statistics South Africa. (2011). Census 2011. Retrieved from http://www.statssa.gov.za/

Steiner, P., Wroblewski, A., & Cook, T. (2009). Randomised experiments and quasi-experimental designs in educational research. In K. E. Ryan & J. B. Cousins (Eds.), *The SAGE international handbook of educational evaluation* (pp. 75-96). Thousand Oaks, California: SAGE Publications

Stewart, D. W., & Shamdasani, P. N. (2015). *Focus groups: theory and practice* (S. Publications Ed. 3 ed.). Los Angeles: Sage Publications.

Stice, J. E. (1987). Using Kolb's Learning Cycle to improve student learning. *Engineering education, 77*(5), 291-296.

Stupans, I., & Owen, S. (2009). Planning and scaffolding for learning in experiential placements in Australian pharmacy schools. *Asia-Pacific Journal of Cooperative Education, 10*(1), 29-37.

Sullivan, G. M. (2014). Is There a Role for Spin Doctors in Med Ed Research? *Journal of graduate medical education, 6*(3), 405-407.

Summers, B., & Mpanda, D. I. (2015). Factors that influence MSc (Med)(Pharmacy) completion rates at the Medunsa Campus of the University of Limpopo, South Africa. *African Journal of Health Professions Education, 6*(2), 129-132.

Summers, L. (2003). On undergraduate education. *Harvard magazine*, 63-65.

Summers, R., Haavik, C., Summers, B., Moola, F., Lowes, M., & Enslin, G. (2001). Pharmaceutical education in the South African multicultural society. *American Journal of Pharmaceutical Education, 65*(2), 150-154.

Tashakkori, A., & Creswell, J. (2007). Editorial: The new era of mixed methods. *Journal of mixed methods research, 1*(1), 3-7.

Tashakkori, A., & Teddlie, C. (Eds.). (2010). *SAGE Handbook of Mixed Methods in Social & Behavioral Research* (2 ed.). Thousand Oaks, California: Sage Publications.

Taylor, S., Best, D., Marriott, J., Dalton, L., Bull, R., Galbraith, K., . . . Rose, M. (2006). Pharmacy student views on preceptorship during rural placements. *Pharmacy Education, 6*(4), 253-266.

Thomas, M. C., & Draugalis, J. (2002). Utility of the pharmacy college admission test (PCAT): implications for admissions committees. *American Journal of Pharmaceutical Education, 66*(1), 47-50.

Thompson, B. M., Schneider, V. F., Haidet, P., Levine, R. E., McMahon, K. K., Perkowski, L. C., & Richards, B. F. (2007). Team-based learning at ten medical schools: two years later. *Medical Education, 41*(3), 250-257.

Thompson, D., Nuffer, W., & Brown, K. (2012). Characteristics valued by the pharmacy practice community when hiring a recently graduated pharmacist. *American Journal of Pharmaceutical Education, 76*(9), Article 170.

Tichelaar, J., van Kan, C., van Unen, R. J., Schneider, A. J., van Agtmael, M. A., de Vries, T. P., & Richir, M. C. (2015). The effect of different levels of realism of context learning on the prescribing competencies of medical students during the clinical

clerkship in internal medicine: an exploratory study. *European journal of clinical pharmacology*, *71*(2), 237-242.

Ting, K. N., Wong, K. T., & Thang, S. M. (2009). Contributions of early work-based learning: A case study of first year pharmacy students. *International Journal of Teaching and Learning in Higher Education, 21*(3), 326-335.

Tsingos, C., Bosnic-Anticevich, S., & Smith, L. (2015). Learning styles and approaches: Can reflective strategies encourage deep learning? *Currents in Pharmacy Teaching and Learning*, *7*(4), 492-504.

Ubaka, C. M., Sansgiry, S. S., & Ukwe, C. V. (2015). Cognitive determinants of academic performance in Nigerian pharmacy schools. *American Journal of Pharmaceutical Education, 79*(7), Article 101.

Unni, E., Zhang, J., Radhakrishnan, R., Smith, K., Bridgen, C., DeYoung, M., & Metzger, T. (2011). Predictors of academic performance of pharmacy students based on admission criteria in a 3-year pharmacy program. *Currents in Pharmacy Teaching and Learning*, *3*, 192-198.

Valdez, C., Namdar, R., & Valuck, R. (2013). Impact of pharmacy experience, GPA, age, education, and therapeutic review on knowledge retention and clinical confidence. *Currents in Pharmacy Teaching and Learning*, *5*, 358-364.

Vermunt, J. D. (1994). Inventory of learning styles in higher education. *Maastricht: Maastricht University*.

Vygotsky, L. S. (Ed.) (1978). *Mind in society: The development of higher psychological processes.* Cambridge, Massachusetts: Harvard University Press.

Wagner, C., Kawulich, B., & Garner, M. (2012). *Doing Social Research*. Berkshire, England: McGraw-Hill Education.

Walker, J., & Almond, P. (2010). *Interpreting Statistical Findings: A guide for health professionals and students*. Berkshire, England: Open University Press, McGraw Hill Education.

Watson, G., & Glaser, E. (1980). *Watson-Glaser critical thinking appraisal manual*. San Antonio, Texas: Psychological Corporation New York

Whelan, A. M., Mansour, S., Farmer, P., & Yung, D. (2007). Moving from a lecture-based to a problem-based learning curriculum-perceptions of preparedness for practice. *Pharmacy Education, 7*(3), 239-247.

Wicherts, J. M., Dolan, C. V., Carlson, J. S., & van der Maas, H. L. (2010). Raven's test performance of sub-Saharan Africans: Average performance, psychometric properties, and the Flynn Effect. *Learning and Individual Differences, 20*(3), 135-151.

Wiedenmayer, K., Summers, R. S., Mackie, C. A., Gous, A. G. S., & Everard, M. (2006). *Developing pharmacy practice: a focus on patient care*. Retrieved from The Hague, Netherlands:

Williams, A., & Katz, L. (2001). The use of focus group methodology in education: some theoretical and practical considerations. *International Electronic Journal for Leadership in Learning, 5*(3). Retrieved from http://iejll.journalhosting.ucalgary.ca/index.php/ijll/article/viewFile/496/158

Williams, B., Brown, T., & Etherington, J. (2013). Learning style preferences of undergraduate pharmacy students. *Currents in Pharmacy Teaching and Learning, 5*(2), 110-119.

Williams, R. L. (2013). Overview of the Flynn effect. *Intelligence, 41*(6), 753-764.

Womble, L. P. (2003). Impact of stress factors on college students academic performance. *Undergraduate journal of Psychology, 16*(1), 16-23.

Wongupparaj, P., Kumari, V., & Morris, R. G. (2015). A cross-temporal meta-analysis of Raven's Progressive Matrices: Age groups and developing versus developed countries. *Intelligence, 49*, 1-9.

Wuller, W. R., & Luer, M. S. (2008). A sequence of Introductory Pharmacy Practice Experiences to address the new standards for experiential learning. *American Journal of Pharmaceutical Education, 72*(4), Article 73.

Yardley, S., Teunissen, P. W., & Dornan, T. (2012). Experiential learning: AMEE guide No. 63. *Medical Teacher, 34*(2), e102-e115.

Zhang, L. J., & Anual, S. B. (2008). The role of vocabulary in reading comprehension: The case of secondary school students learning English in Singapore. *RELC Journal, 39*(1), 51-76.

APPENDIX A: ETHICAL APPROVAL FROM NMMU RESEARCH ETHICS COMMITTEE

• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

Nelson Mandela Metropolitan University
for tomorrow

Chairperson: Research Ethics Committee (Human)
Tel: +27 (0)41 504-2235

Ref: [H13-HEA-PHA-008/Approval]

RECH Secretariat: Mrs U Spies

17 October 2013

Ms S-A Boschmans
Faculty of Health Sciences
Pharmacy
12-03-55
South Campus

Dear Ms Boschmans

EXPERIENTIAL LEARNING IN AN UNDERGRADUATE BPHARM PROGRAMME: IMPACT OF AN INTERVENTION ON ACADEMIC ACHIEVEMENT

PRP: Ms S-A Boschmans
PI: Ms J McCartney

Your above-entitled application for ethics approval served at the Research Ethics Committee (Human).

We take pleasure in informing you that the application was approved by the Committee.

The ethics clearance reference number is **H13-HEA-PHA-008**, and is valid for three years. Please inform the REC-H, via your faculty representative, if any changes (particularly in the methodology) occur during this time. An annual affirmation to the effect that the protocols in use are still those for which approval was granted, will be required from you. You will be reminded timeously of this responsibility, and will receive the necessary documentation well in advance of any deadline.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely

CB Cilliers

Prof CB Cilliers
Chairperson: Research Ethics Committee (Human)

cc: Department of Research Capacity Development
Faculty Officer: Health Sciences

APPENDIX B: CONSENT FORMS

• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

Nelson Mandela Metropolitan University
for tomorrow

SOUTH CAMPUS
PHARMACY DEPARTMENT
Tel: +27415042631 Fax. +27415042744
jane.mccartney@nmmu.ac.za
13th March 2015

Ref: Contact person: Mrs J McCartney

Dear 4th year BPharm student

RE: INFORMED CONSENT TO ASSIST WITH A RESEARCH STUDY

You are being asked to assist with a study that aims to identify the factors that influence students' ability to apply pharmacological knowledge when problem solving in the clinical (hospital) setting. The goal is to develop and implement an intervention aimed at improving academic achievement amongst final year BPharm students.

During the study, data will be collected pertaining to: your admission criteria for the BPharm degree, your educational background, your academic record, your English reading comprehension ability and day to day language use, your learning style preferences and your problem solving ability. Your module marks will also be used in the study. You may be asked to volunteer to participate in a small focus group discussion which will focus on your experiences of the hospital programme.

You will need to provide written informed consent (see page 2). Your involvement is voluntary and you have the right to withdraw from the study at any given time. Any problems encountered during the study can be discussed with the researcher or the Head of the Department of Pharmacy. Your identity as a participant will at all times remain confidential, as your name will not be linked to the data (data identifiers in the form of a unique study number will be assigned to each participant by an independent data capturer).

The study has been approved by the Research Ethics Committee (Human) of the university. The REC-H consists of a group of independent experts that has the responsibility to ensure that the rights and welfare of participants in research are protected and that studies are conducted in an ethical manner.

Yours sincerely,
Jane McCartney (Researcher)

Should you agree to participate in the research, please turn to page 2 and sign the Informed Consent Form provided.

NELSON MANDELA METROPOLITAN UNIVERSITY

INFORMATION AND INFORMED CONSENT FORM

RESEARCHER'S DETAILS	
Title of the research project	**EXPERIENTIAL LEARNING IN AN UNDERGRADUATE BPHARM PROGRAMME: INTERVENTION TO IMPROVE ACADEMIC ACHIEVEMENT**
Reference number	H13-HEA-PHA-008
Principal investigator	**Jane McCartney**
Address	**Pharmacy Department, Faculty of Health Sciences, PO Box 77000 Nelson Mandela Metropolitan University Port Elizabeth**
Postal Code	**6031**
Contact telephone number (private numbers not advisable)	**041-5042735**

A. DECLARATION BY PARTICIPANT			Initial
I, the participant and the undersigned	(full names)		
NMMU Student Number			
Assigned Unique Study Code	(not for student use)		

A.1 HEREBY CONFIRM AS FOLLOWS:		Initial
I, the participant, was invited to participate in the above-mentioned research project that is being undertaken by Mrs Jane McCartney, from the Department of Pharmacy, NMMU. i) I understand the aim of the research which was described in page 1. ii) I also understand that my involvement is voluntary, and that I may withdraw as a participant in the research at any time. Iii) I understand that my identity as a participant will not be revealed in any scientific publications or presentation, and that my confidentiality as a participant will be maintained. iv) I understand that my name or any personal identifier will not be linked to the data set that will be used by the researcher.		

A.2 I HEREBY VOLUNTARILY CONSENT TO PARTICIPATE IN THE ABOVE-MENTIONED PROJECT:				
Signed/confirmed at	PORT ELIZABETH (NMMU)	on	(day / month / year)	
				Signature of participant

B. IMPORTANT MESSAGE TO PARTICIPANT
Dear participant Thank you for your participation in this study. Should, at any time during the study, should you require any further information or need to discuss anything regarding the research, please feel free to contact me. Jane McCartney (Office number: 120355; phone number: 041-5042735; email: jane.mccartney@nmmu.ac.za

APPENDIX C: EXAMPLE OF AN OPEN BOOK EXAM

November 2014 – Module Code:ZCL401

NOVEMBER 2014 EXAMINATION

Nelson Mandela Metropolitan University
for tomorrow

MODULE DESCRIPTION	:	PHARMACOLOGY4: APPLIED THERAPEUTICS
MODULE CODE	:	ZCL401
FACULTY	:	FACULTY OF HEALTH SCIENCES
QUALIFICATION	:	BPharm
EXAMINATION DATE	:	7th November 2014
SESSION	:	09:00 / 14:00
DURATION (IN MINUTES)	:	225 minutes (3 hours 45 minutes)
TOTAL MARKS	:	30 marks
PAGES	:	4

INSTRUCTIONS
i. ANSWER EACH QUESTION IN A SEPARATE ANSWER BOOK
ii. ANALYSE EACH CASE FOR MEDICINE-RELATED PROBLEMS AND MAKE SUITABLE RECOMMENDATIONS IN ORDER TO OPTIMISE THERAPY

REQUIREMENTS
i. THREE ANSWER BOOKS PER CANDIDATE
ii. HAND IN QUESTION PAPER AT END OF EXAMINATION
iii. OPEN BOOK EXAMINATION - CANDIDATES MAY USE ANY PRINTED REFERENCE EXCEPT ELECTRONIC DEVICES.
iv. CALCULATORS MAY NOT BE SHARED.

STUDENT NUMBER _____STUDENT NAME: _____

DO NOT TURN THE PAGE BEFORE TOLD TO DO SO

Section A (10 marks) - ZCL401 APPLIED THERAPEUTICS – NOVEMBER 2014 – Paper 2

PATIENT: Mr Mtini **MASS**: 87 kgs

AGE: 42 yrs **HEIGHT:** 168 cm

SEX: Male

SOCIAL HISTORY:

Compliance: Generally compliant with prescribed medication

Alcohol: works in Marketing and Sales, and regularly "wines and dines" clients

Tobacco: non-smoker

Date	Symptoms/ Complaints	Diagnosis/ Problem	Drug	Dose	Date start	Date stop	Remarks/ Observations
5-Sept-2014	Annual checkup with GP	Newly diagnosed hypertension with ischaemic heart disease	Moduretic® Tilazem® CR 180 mg	1 tablet po mane 1 capsule po daily	4-Sept-2014 4-Sept-2014		• BP 155/95 • IHD detected on ECG during exercise stress test • Total cholesterol = 4 mmol/l • U&E and FBC was within normal limits
7-Nov-2014	Mr Mtini has severe pain in right big toe joint – area is red, hot to touch, swollen & extremely tender	Acute gouty arthritis ***09h00*** Pharmacist initiated therapy – tablets started	Arthrexin® 50mg capsules Colchicine® 0.5mg tablets	50mg tds pc po until pain subsides 2 tablets stat then 1 tablet 2 hourly until pain is relieved	7-Nov-2014 7-Nov-2014		As he is away from home, Mr Mtini visits the local community pharmacist for help – he is advised that this sounds like a gout attack.
7-Nov-2014	***15h00:*** Mr Mtini is in agony and battling to walk – so his colleague who is with him, kindly gives him some of his Puricos® 300mg tablets, and tells Mr Mtini to take 1 tablet a day, as these tablets have completely stopped his gout attacks.						

Section B (10 marks) - ZCL401 APPLIED THERAPEUTICS – NOVEMBER 2014 – Paper 2

PATIENT: Mrs H Brown **SEX**: Female **AGE**: 35 years

MASS: 52 kg **HEIGHT:** 160 cm

SOCIAL HISTORY:

Compliance: relatively compliant with meds

Alcohol: None **Tobacco**: None

LABORATORY INVESTIGATIONS

	Patient's Results		
LAB INVESTIGATION AND NORMAL VALUES	**1-04-2014**	**19-05-2014**	**5-08-2014**
CD4 count: 500 cells/mm^3 to 1,200 cells/mm^3	175	230	200
Viral Load: Undetected (copies/ml)	6000	3500	6000

Date	Symptoms/ Complaints	Diagnosis/ Problem	Drug	Dose	Date start	Date stop	Remarks/ Observations
1-April-2014		RVD+ve	Tenofovir (TDF), Emtricitabine (FTC) Efavirenz (EFV).	300mg od 200mg od 600mg od	1-04-2014 1-04-2014 1-04-2014	Continue Continue continue	
2-May-2014	Mild rash with pruritis but no fever, facial oedema, elevated ALT or blistering		Tenofovir (TDF), Emtricitabine (FTC) Efavirenz (EFV) Prednisone	300mg od 200mg od 600mg od 20mg po daily	2-05-2014 2-05-2014 2-05-2014 2-05-2014	Continue Continue Continue 6-05-2014	
2-June-2014			Tenofovir (TDF), Emtricitabine (FTC) Efavirenz (EFV).	300mg od 200mg od 600mg od	2-06-2014 2-06-2014 2-06-2014	5-08-2014 5-08-2014 5-08-2014	Patient collected monthly repeat of medication in July '14
5-Aug-2014		Regime 1 failure	Tenofovir (TDF) Emtricitabine (FTC) Lopinavir / Ritonavir (LPV/r)	300mg od 200mg od 800/200mg od	5-08-2014 5-08-2014 5-08-2014	Continue Continue Continue	Patient collected monthly repeat of new treatment regimen in Sept and Oct 2014
3-Nov-2014			Tenofovir TDF Emtricitabine FTC Lopinavir / Ritonavir (LPV/r)	300mg od 200mg od 400/100mg od	5-08-2014 5-08-2014 5-08-2014	Continue Continue Continue	Bloods taken for lipid assessment
7-Nov-2014		Elevated triglyceride levels	Simvastatin	20mg daily	7-11-2014	continue	Results from blood sample taken on 1/11/2014: Triglycerides 11.5mmol/l (normal range: <1.8mmol/l)

Section C (10 marks) - ZCL401 APPLIED THERAPEUTICS – NOVEMBER 2014 – Paper 2

PATIENT	John Black	***FAMILY HISTORY:*** John's grandfather was diagnosed with Schizophrenia in his early twenties. There was no other family history of psychiatric disorders.
SEX:	Male	
AGE	26-years of age	**August 2014**:
MASS:	90kgs	John's colleague reported that he had suddenly lost interest in looking after hims and that he started to arrive for work unshaven and wearing dirty clothes. John's
HEIGHT:	1.90m	prescribed Dormonoct® tablets for him at 1-2 tablets nocté (repeat x 6 months)
GENERAL:	John is a policeman who is dedicated to protecting the Port Elizabeth community	because he was having trouble falling asleep.

Date	*Symptoms/ Complaints*	*Diagnosis/ Problem*	*Drug*	*Dose*	*Date start*	*Date stop*	*Additional information*
05-11-2014	John started acting strangely at the police station. He started yelling: "The aliens are after me! I need to go now!" He was alone, but he made hand gestures that suggested that he was talking to someone.	Paranoid Schizophrenia	Haloperidol injection	5mg stat IM and then PRN	05-11-2014	05-11-2014	John's colleague called the hospital and the paramedics arrived at the scene shortly thereafter. John seemed to have settled down after two IM injections of haloperidol. However, he was admitted to the nearest psychiatric hospital for further evaluation.
06-11-2014	Indecisive, talks to himself, confused	Paranoid Schizophrenia	Haloperidol tablets	5mg nocté	06-11-2014		John was initiated on chronic therapy for his condition.
	Neck pain (due to having slept awkwardly last night)		Adco-dol® Dormonoct®	2 tablets PRN 2 tablets nocté	06-11-2014 06-11-2014		John's father went to visit him and took him some Adco-dols® and Dormonoct® because John had complained about neck pain and difficulty falling asleep.
07-11-2014	Drowsy, dizzy and confused, slurring words, ataxia	Exacerbation of Paranoid Schizophrenia?	Haloperidol® tablets	10mg nocté	07-11-2014		John's BP was 96/70.

APPENDIX D: ELP QUESTIONNAIRE

SURVEY OF BPHARM-4 STUDENTS (BEFORE HOSPITAL ROTATIONS BEGIN)

Please place an X in the appropriate space OR provide the requested information in the allocated space. Please PRINT clearly.

SECTION A: DEMOGRAPHICAL INFORMATION					
A1	**Unique Study Number**	(For use by independent coder)			
A2	**Gender**	MALE	FEMALE	**Date of Birth**	
A3	**Place of Birth**	TOWN		COUNTRY	
A4	**Citizenship**	SOUTH AFRICAN		OTHER (please specify)	
A5	**Country of permanent residence**				
SECTION B: ACADEMIC JOURNEY THROUGH BPHARM PROGRAMME					
B1	Year of first registration in BPharm at NMMU		Registered for BPharm over **4 years**	Registered for BPharm over **5 years**	
SECTION C: LANGUAGE HISTORY					
C1	What is your mother tongue? (ie language first spoken). If more than one, please list all.				
C2	Please specify the language(s) you would use in the following situations. If more than one language is used in a particular situation, please indicate the % of use (eg English 60%;Xhosa 40%)				
	At home with family		On campus (social)		
	At NMMU when working in groups		At NMMU when studying		
	Language of instruction at junior school		Language of assessment at junior school		
	Language of instruction at high school		Language of assessment at high school		

SECTION D: PHARMACY-RELATED WORK EXPERIENCE					
D1	Have you had any work related experience in a pharmacy environment			YES	NO
D2	If **YES,** please indicate with **X** the nature of work experience that you have had. You may select more than one option.				
	Community pharmacy		Hospital pharmacy		
	Manufacturing industry		Primary care clinic		
	Wholesale / distribution		Veterinary pharmacy		
D3	Over a year, how many hours have you spent working in one or more of these pharmacy environments?				
	Short block periods during vacation time (less than 4 weeks a year)		Short block periods during vacation time (4 to 8 weeks a year)		
	Less than 3 hours per week		Between 3 and 10 hours per week		
	11 to 20 hours per week		I have not been able to get work experience		
D4	If you have had **work experience in a pharmacy environment, complete D4**. For each of the following activities, identify the frequency of your involvement. This will provide the researcher with a breakdown of your overall work based experience as a pharmacy student, and requires some careful consideration.				
4.1	Stock management (receiving, unpacking, checking and ordering)				
	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
4.2.	Assisting with dispensing by fetching stock items, preparing the prescription or manufacturing or compounding items				
	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
4.3.	Reading prescriptions and dispensing, for checking by the pharmacist				

	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
4.4	Providing the patient with the dispensed medication and appropriate patient counselling				
	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
4.5	Phoning the prescriber for clarification of the prescription				
	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
4.6	Recommending OTC products and counseling the patient				
	1 = seldom	2 = occasionally	3 = half of my time at work	4 = often	5 = frequently
THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE					

APPENDIX E: CAAR_REQUEST TO USE ENGLISH READING COMPREHENSION TEST

• PO Box 77000 • Nelson Mandela Metropolitan University
• Port Elizabeth • 6031 • South Africa • www.nmmu.ac.za

Nelson Mandela Metropolitan University
for tomorrow

Summerstrand South Campus
Centre for Access Assessment & Research
Tel: +27 (0)41 504 2796
dave.jenkings@nmmu.ac.za

Ref: Permission to use CAAR Test

Contact person: Dave Jenkings

25 July 2016

Dear Professor Boschmans and Ms McCartney

This letter serves to confirm that permission was granted for the Pharmacy Department to use the CAAR Reading Comprehension Test to collect data as part of a study titled:

Experiential Learning in an Undergraduate BPharm Programme: Impact of an Intervention on Academic Acheivement

BPharm 4th-year students were assessed by CAAR in 2014 and 2015, after they had provided written consent to participate. Proof of ethics clearance obtained from the NMMU REC-H Committee – reference H13-HEA-PHA-008 – was submitted to the Centre as requested.

Yours sincerely

Dave Jenkings
Director: CAAR

APPENDIX F: KOLB LSI RESEARCH

McCartney, Jane (Mrs) (Summerstrand Campus South)

Subject: Kolb LSI Research

From: Joe McDonald [mailto:Joe.McDonald@haygroup.com]
Sent: Monday, August 24, 2015 3:09 PM
To: McCartney, Jane (Mrs) (Summerstrand Campus South)
Subject: RE: LSI Research

Hi Jane,

Congratulations! Your LSI research has been approved! Attached you will find the following documents:

- MCB200C - This is a copy of the LSI 3.1 test. You may print of copy this as needed for your research.
- MCB200D - The profile sheet contains the answer key for the test as well as the profiling graphs for plotting scores. This document may be produced as necessary for your research. The AC-CE score on the Learning Style Type Grid is obtained by subtracting the CE score from the AC score. Similarly, the AE-RO score is AE minus RO.

These files are for your data collection only. This permission does not extend to include a copy of the files in your research paper. It should be sufficient to source it.

We wish you luck with your research and look forward to hearing about your findings. Please send a completed copy of your research to Joe.McDonald@haygroup.com or you can mail a hardcopy to:

LSI Research Contracts
c/o Joe McDonald
Hay Group, Inc.
399 Boylston Street
4th Floor, Suite 400
Boston, MA 02116

Please let me know if you have any questions.

Kind regards,

Joe

APPENDIX G: PHARMACOLOGY4 MODULE FEEDBACK QUESTIONNAIRE

PHARMACOLOGY4 MODULE FEEDBACK QUESTIONNAIRE
(2013 and 2014)

PLEASE FEEL FREE TO WRITE YOUR PERSONAL COMMENTS OR SUGGESTIONS IN THE ANSWER BOOKS PROVIDED

***Question 1*:**

What aspects of the module did you find to be the *most difficult*?

Question 2:

What aspects of the module did you find to be *most beneficial* to your understanding and integration of pharmacology?

***Question 3*:**

What *changes* could be made to improve the current programme which would help future students integrate and apply their knowledge of pharmacology?

Thank you for taking the time to provide us with feedback - your input is greatly appreciated.

APPENDIX H: POST INTERVENTION FEEDBACK QUESTIONNAIRE

PHARMACOLOGY4 POST-INTERVENTION FEEDBACK QUESTIONNAIRE (2015)

PLEASE FEEL FREE TO WRITE YOUR PERSONAL COMMENTS OR SUGGESTIONS IN THE ANSWER BOOKS PROVIDED

Question 1:

How did you find the structure and format of the academic support sessions that were conducted in the afternoon report-back sessions?

Question 2:

Did a more structured approach to patient case analysis help you apply and integrate information, both in the hospital environment as well as in the open book tests?

Question 3:

Did you find that you learnt from your peers during the discussions in the academic support sessions that were conducted in the afternoon reportback sessions?

Thank you for taking the time to provide us with feedback - your input is greatly appreciated.