

1. Introduction

1.1 Problem Statement

According to the World Health Organization (WHO) (De Vries *et al*,1994) rational prescribing is the process of ensuring that the correct medicine is used by an individual patient for a specific diagnosis, in the correct dose over the correct period of time. The drug regimen selected should be available in the appropriate quality and quantity, and the cost of the prescription should be within the patient's economic means. The process includes provision of sufficient patient counselling to ensure patient compliance. Prescribing medicines is the primary intervention that most doctors offer to influence their patients' health, thus development of rational prescribing skills is a core competency required of all doctors from graduation (Dent & Harden, 2005).

Although medicines are the most common form of therapeutic intervention, they are also the most common cause of iatrogenic disease, and a number of important trends increase the pressure on prescribers to make safe, rational choices (Aronson, 2006). Examples of these include: new drug development, including the extension of medicine into new areas such as pharmacogenomics; increased use of medicines in both primary and secondary care; the increasing complexity of medical care in tertiary institutions or, conversely, a lack of essential medicines in management of rural cases; increased specialization; more rapid throughput of patients; and sicker and/or older patients who are more vulnerable to adverse effects of medication. These pressures explain, in part, an increasing trend in harm from adverse events related to drug therapy and medication errors (Maxwell *et al*, 2006)

Prescribing audits conducted in the UK have noted an increase in the estimated incidence and impact of non-rational prescribing leading to errors causing patient morbidity and mortality (Maxwell *et al*, 2002). For example, the UK Audit Commission report *A Spoonful of Sugar* (2001) stated that almost 1100 people died in England and Wales in 2001 as a result of prescribed drug therapy errors, a fivefold increase from 1991. Whilst the increasing pressure on prescribers can account for some of these events, it is of relevance that interns and junior doctors have been strongly implicated in causality of the escalating occurrence of drug-related morbidity and mortality. The allegation is that junior doctors make more errors than their experienced senior colleagues and that the origins of this incapability lie in insufficient undergraduate education in rational prescribing skills. Audit commissioners contend that

medical courses “do not provide a thorough knowledge of safe medicines prescribing and administration” for junior doctors (*ibid*).

This assertion has been strongly contested by the General Medical Council (GMC) of the UK, the body responsible for setting competency outcomes for graduation of medical practitioners. Professor Peter Rubin, the Chairman of the education committee of the GMC states that prescribing has traditionally been learned “as an apprentice” in the internship year, and that students’ training is not deficient.

“Medical education is a continuum. With respect to prescribing, as with so many other areas of medical education, we expect principles to be learnt and understood at medical school and then put into practice, under supervision, during the F1 [internship – SM] year.” (Rubin, 2006).

The UK GMC has set out the standards for knowledge, skills, attitudes and behaviours that medical students should learn at UK medical schools in a document known as “*Tomorrow’s Doctors*” (General Medical Council, 2003). The committee has called for recognition that the exponential increase in biomedical knowledge means that in medical school, students cannot learn everything pertaining to the specialized and super-specialized practice of medicine, since this factual burden is not only too high, but rapidly becomes outdated. Rather, they should be taught principles of medical practice, skills in information retrieval and analysis and be encouraged to develop self-learning strategies and reflective practices that motivate life-long learning (GMC, 2003).

However, Dr Simon Maxwell, a senior lecturer in Clinical Pharmacology at the University of Edinburgh has conducted several studies on student preparedness to prescribe, and has become an outspoken critic of undergraduate preparation in UK medical schools. His latest survey of medical students and recent graduates in the UK showed that only 29% of the 2413 respondents felt confident to prescribe on completion of their formal medical studies (Heaton *et al*, 2008), highlighting a gap between workplace prescribing demands placed on newly qualified doctors and their preparation for this complex activity during undergraduate training. Similar student perceptions have been reported in Australia (Coombes *et al*, 2008a) and the USA (Garbutt *et al*, 2005).

Maxwell’s contention is that by following the recommendations in *Tomorrow’s Doctors*, which include integration of curricula and the reduction of factual burden, the actual content of pharmacology taught, and the importance assigned to integration of clinical pharmacology into rational prescribing decisions in assessments is so reduced as to compromise the safe

practice of medicine (Maxwell, 2003). Other British practitioners have published studies which concur with this view (Dean *et al*, 2002a; Conroy *et al*, 2008; Kroll *et al*, 2008) as have doctors in Canada (Cadieux *et al*, 2007), the USA (Fischer *et al*, 2006; Martinez & Lo, 2008; Kaldjian *et al*, 2008), Australia (Coombes *et al*, 2008b), Finland (Kuitunen *et al*, 2008) and Europe (Maxwell *et al*, 2007).

This controversy has stimulated me to wonder about prescribing competence of South African medical graduates and, in particular, our Wits graduates. Are they competent to prescribe on graduation? Are there elements of the global problem that apply to our particular situation? Do we teach principles of rational prescribing practice and how do we test this competence before students graduate? Do students feel adequately prepared for prescribing practice and what factors do they think influence epistemic access to prescribing knowledge, skills and behaviours?

In order to investigate some of these issues, in this study I analyzed rational prescribing performance in the exit-level integrated examination which final-year medical students wrote as evidence of their fitness to practice the profession. In addition, I classified the examination questions within a hierarchy of educational objectives in order to offer insight into the types of knowledge and styles of learning valued by the University. Then, examination performance was contrasted with students' perceptions of their competence to prescribe and these results informed the discussion on possible factors which students felt affected acquisition of rational prescribing competence.

1.2 Importance of the Research

Prescribing is a common activity across the whole spectrum of medical practice. Pearson (2002) notes that prescribing habits formed in the early years of medical practice are likely to determine a doctor's approach to prescribing in subsequent medical life, thus, the timely acquisition and maintenance of an adequate and operational knowledge of rational prescribing is a necessity for doctors to practice safely and effectively.

Not only is this competence essential to their successful management of patients' ailments, but also adverse reactions to drugs and drug-drug interactions are a significant cause of iatrogenic morbidity and mortality (Anderson, 2004). An adverse event is defined as an unintended injury or complication of drug therapy. This may result in prolonging the patient's

stay in hospital, or it may cause disability or death unrelated to the patient's underlying disease process. Aside from the direct harm to the patient, adverse effects impose a considerable financial burden on the healthcare system (de Vries *et al*, 2008). Commonly cited medical errors which give rise to drug-related adverse events include prescription of the wrong drug, incorrect formulation, dose, frequency or route of administration, ignoring contraindications or drug interactions and poor communication with patients about their medicines. Thus, failing to master a working knowledge of prescribing has severe economic as well as potentially fatal consequences (Dean *et al*, 2002b).

In the current global health care economy, as will be seen in the discussion of “context of the research”, there is a move towards management of illness at a primary healthcare level, rather than costly, tertiary interventions. With respect to provision of medicine, this has translated into widened responsibility for prescribing and distribution of medicines. Thus, whereas before, the doctor provided a “gatekeeper” function in controlling the choice of medicine for a patient, now the legal and professional boundaries of nurses, pharmacists, clinical associates and physiotherapists have been extended to include limited prescribing duties. In order to be granted these prescribing privileges, these “allied disciplines” have to undergo additional training in rational drug use. The point here is twofold: Firstly, if doctors wish to retain professional standing and full prescribing rights in a context where they are *not* the only prescribers, then they have to be as well-trained (if not better) than the ancillary prescribers. Secondly, doctors may be required to fulfill the role of instructor or even auditor for these secondary prescribers, and they need to be equipped to interpret and adjudicate prescribing decisions of others (as well as being self-reflective of their own choices.)

The preceding points highlight the necessity for doctors to develop rational prescribing competence. The importance of this research project was that it initiated an enquiry into *how* prospective doctors might develop this competence through their medical studies. Located in the specific context of the Graduate Medical Entry Programme (hereinafter referred to as the GEMP) at the University of the Witwatersrand (Wits), the work contributes to the debate on the prerequisites for developing regionalized knowledge and explores the consequences of an integrated curriculum on students' construction of knowledge.

The findings of this research could be of interest to staff involved in pharmacology curriculum development and assessment, GEMP staff involved in PBL development and assessment, GEMP staff involved in clinical training, faculty policymakers involved in

student enrollment, faculty policymakers involved in determining standards for graduation, members of the Health Professions' Council of South Africa (HPCSA) who determine standards for professional competence, government ministries (eg Health and Finance) involved in national health policy structuring and Board of Health Care Funders (Medical aids) involved in drug funding structures.

In discussing the “ideal” medical curriculum for the 21st Century, Jamshidi and Cook (2003) lament that we would be further ahead if each intervention in medical education had been examined to determine what outcomes were achieved. “Possibly the key to accelerating needed change is the rapid accumulation of experimental data in medical education”. This research aims to produce a “point of reference” for assessment of prescribing competence of Wits medical graduates and to examine student perceptions of factors which affect the acquisition of this therapeutic proficiency.

1.3 Research Aims

The purpose of this study is to explore exit-level assessment of rational prescribing skills of final year GEMP students in contrast to students' self-perceptions of their prescribing skills. Further, this research seeks to probe factors which affect students' access to prescribing competence in the integrated curriculum.

The study aims to respond to the major question:

Is there concordance between the “exit-level” competence in rational prescribing skills as delineated by the University and student perceptions of their preparation and ability to prescribe?

1.4 Research Questions

The major question can be fragmented into sub-questions:

- a. How do students perform in the final integrated assessments with respect to rational prescribing skills?
- b. How does student examination performance correlate with students' perceptions of competence?
- c. How does the GEMP assess rational prescribing competence in the final integrated examinations?
- d. How do students perceive delivery of rational prescribing skills in the GEMP curriculum?
- e. What factors do students identify as influential in their learning of rational prescribing skills?

1.5 Theoretical Framework

A primary focus of this study is the investigation of the final, “exit-level” GEMP examinations for evidence of adjudicating rational prescribing skills. An appropriate starting point for this endeavour would be to delineate what counts as rational prescribing skills, followed by the question “how can we say that a student has come to know rational prescribing?”

1.5.1 The Nature of Rational Prescribing Skills

Maxwell and Walley (2003) explain that prescribing is a complex activity that relies on making judgments on the basis of incomplete and sometimes conflicting information. In order to facilitate these complex decisions, a sound knowledge of the “building blocks” which contribute to informing these choices is necessary. In this study I applied Bernstein’s (2000) elucidation on the nature of knowledge and its systems as a framework for considering the nature of rational prescribing knowledge. Bernstein describes singulars as specialist knowledge structures with a discrete discourse and strong boundaries that are reinforced by the academy as to what counts as knowledge in that singular. In the context of rational prescribing, the discipline of *pharmacology*, which is the science of drug action on biological systems and *clinical therapeutics*, the application of drugs to particular clinical problems, are both singulars.

According to Bernstein, regions are assembled by recontextualising disciplinary knowledge into a practical interface between the academic “silos” of knowledge and their applicability in a real-world situation. Rational prescribing is thus a Bernsteinian region, and is subject to different levels of power and control than those exerted on the singulars.

In discussing the nature of rational prescribing and its place within the curriculum, I therefore applied a Bernsteinian lens to the selection, sequencing, pacing and criteria of the singulars which contribute to this skill and their incorporation into regions. This analysis was guided by Bernstein’s (2000) delineation of the regulative discourse, concerned with the teacher codes of classification and framing and the instructional discourse, associated with the learner codes of recognition and realization rules which affected epistemic access.

1.5.2 Assessment of Rational Prescribing Skills

In answering the question “How do we know what we know”, various “conceptions of knowing” have been proposed. Bloom (1956) proposed a taxonomy for classifying learning objectives in the cognitive, affective and psychomotor domains of learning, providing a basis for sequentially categorizing knowledge, attitudes and skills in the respective domains from the simplest behaviour to the most complex.

Anderson and Krathwohl, (2001) revised the taxonomy by altering the terminology from nouns to verbs and re-evaluating the hierarchy of synthesis and evaluation. Further, they extended the structure of the table from one dimension into two, retaining the original cognitive process dimension and adding a “knowledge” dimension which categorises knowledge as factual, conceptual, procedural or metacognitive. They produced a resultant table which can classify objectives according to the knowledge dimension, as well as the dimension of cognitive challenge (Table 1 overleaf). This taxonomy was used to classify all the MCQ statements in the examination pertaining to rational prescribing competence – to aid in the adjudication of fitness of purpose and level of cognitive challenge.

Table 1: Bloom’s Revised Taxonomy	
	The Cognitive Process Dimension

The Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	List	Summarize	Classify	Order	Rank	Combine
Conceptual Knowledge	Describe	Interpret	Experiment	Explain	Assess	Plan
Procedural Knowledge	Tabulate	Predict	Calculate	Differentiate	Conclude	Compose
Meta-Cognitive Knowledge	Appropriate Use	Execute	Construct	Achieve	Action	Actualize

(Adapted from Fisher, 2007)

Biggs (2003) described the concept of “constructive alignment” where objectives are determined, then explicated by suitable teaching and learning activities which are then adjudicated by appropriate assessments. In an aligned system, the objectives cover both the content to be learned as well as the level of understanding required to be exhibited in assessment of this content. He devised the structure of the observed learning outcome (SOLO) taxonomy which relates five levels of responses at which learners can respond to academic tasks as an explication of the levels at which content should be learned (Biggs & Collis, 1982). These include pre-structural, uni-structural, multi-structural, relational and extended abstract, in order to provide a basis for the delineation of constructive alignment. As a comparator for the levels at which content was examined, the SOLO taxonomy was used to view the assessment questions in the prescribing examination.

1.5.3 Factors affecting epistemic access

The categorisation of rational prescribing as a professional practice was developed by consideration of the knowledge structures of the singular discipline of pharmacology in comparison with the region, rational prescribing, according to Maton (2009) and Muller's (2009) extension of Bernstein's work (2000). Maton discusses the concepts of cumulative and segmented learning whilst Muller theorises conceptual versus contextual curricula. They both conclude that the types of disciplinary structures which students access have implications for the transferability of learning between contexts.

In addition, development of professional competence in rational prescribing was explored by analysis of perceptions of students as participants in a community of practice, as described by Lave and Wenger (1991). They proposed the concept that development of professional competence and identity is influenced by the specific social context in which learning occurs. This lens was applied as a model of enculturation into the practice of rational prescribing.

2.3.. Outline of Remaining Chapters

Chapter Two describes the context of this research project. General changes in the approach to medical education over the past 20 years are discussed and specific changes to the medical curriculum at Wits are described. Thereafter, I delineate specific international policies relating to developing curricula to teach rational prescribing competence and then point out the local South African perspectives on teaching prescribing. The penultimate segment of this chapter contains an exposition of the intended prescribing curriculum within the GEMP accompanied by an account of some of the educational theories which underpin curriculum delivery. Lastly, the specific context of the Division of Pharmacology as the locus of pharmacology teaching is documented.

Chapter Three comprises a review of the literature in the areas of prescribing competence and student perceptions of prescribing competence. A distinction is drawn between competence and professional proficiency, and methods of measuring competence are reviewed. Specifically, the use of single-best answer multiple choice questions and extended matching questions within medical education are discussed. Then, the use of Bloom's taxonomy and the SOLO taxonomy to classify medical assessment questions is documented. The chapter concludes with a section on reports of international student perceptions of

prescribing competence followed by South African studies which have alluded to prescribing competence of medical graduates.

Chapter Four details the research design of the project. Justification for the case study approach is followed by delineation of the research tools and data collection methods. Validity, reliability and trustworthiness of the data are discussed followed by a consideration of the ethical issues implicit in research of this nature.

Chapter Five is an account of the research findings of the study and interpretations. The juxtaposition of these two sections is intended to increase the coherence of the discussion by analysis of the varied reported results in relation to applicable concepts. An account of student performance in the prescribing examination is followed by analysis of the MCQ item construction. The discussion of prescribing performance is concluded with a report on prescribing marks in relation to the full examination marks and the implications of poor prescribing performance for eventual professional practice. The next section in this chapter reveals the lack of correlation between student examination performance and students' perceptions of prescribing competence. This is followed by analysis of the prescribing examination questions according to the SOLO taxonomy, Bloom's revised taxonomy and also in relation to policy documents concerning prescribing outcomes. Section 5.4 documents students' perceptions of curricular delivery of rational prescribing skills in relation to quantity and sequencing of basic pharmacology. The subsequent section deals with the notion of situated learning and, in addition, student perceptions of examinations as a factor which they identify as influential in their learning of rational prescribing skills. Lastly, a Bernsteinian lens is used to view a synthesis of the findings in relation to issues of power and control in delivery of the rational prescribing curriculum within the GEMP and the ultimate effects on students' access to the practice.

Chapter Six records the conclusions drawn from the study in relation to its limitations, makes recommendations on the basis of the research and advances ideas for future investigations.

References and Appendices follow thereafter.

CHAPTER 2: CONTEXT OF THE RESEARCH

2.1 Changes in Approach to Medical Education

Towards the end of the twentieth century, the confluence of many differing influences forced a reappraisal of medical education: the shift of patients from “recipients” of healthcare to “partners” in the promotion of their health presaged an epistemological epiphany which was further exacerbated by an exponential amplification of biomedical knowledge and skills. The influence of economics on the provision of healthcare and the resultant change in emphasis from hospitalization to ambulatory care promoted the transfer in emphasis from specialized to primary health care.

Many medical schools worldwide reviewed their curricula and pedagogy to reflect these new definitions of health, disease and the role of the doctor in society. Medical education in South Africa has followed the international trend, at the same time as implementing the post-apartheid government’s mandate of transformation of the healthcare service to provide essential primary health care for all, rather than specialized care for the few (Department of Health, 1996; 1997). Doctors in the “New” South Africa have to serve the needs of the diverse population by integrating patient health management into the context of the social and cultural situation in which they practice (Kent & de Villiers, 2007).

2.2 The New Medical Curriculum at the University of the Witwatersrand

In 2003, after extensive international and local research, the Faculty of Health Sciences at the University of The Witwatersrand (Wits) launched a new curriculum to train medical doctors (culminating in the degrees of Bachelor of Medicine and Surgery, MBChB). This new approach to medical training incorporated the government’s emphasis on delivery of primary health care, and also facilitated improved access to the profession via a graduate entry pathway. The resultant student diversity was intended as a strength of the programme rather than a limitation, since the constructivist principles of the programme design encourage student-centred self-learning, rather than didactic delivery of volumes of information – a situation in which diversity in students’ prior learning and culture adds to the group learning experience.

The 4-year integrated curriculum is known as the Graduate Entry Medical Programme (GEMP). This is a computer-delivered programme where the emphasis is on small group learning and independent student study. Groups of up to 8 students are allocated to work together for a six month period and, in GEMP I and II they are based in a “home room” which contains the prescribed textbooks for the course and a computer with internet access. Each week a new clinical case is presented to the students via computer terminals in their home room. Students follow a problem-solving protocol by identifying learning issues which need to be addressed by the group in order to decide on appropriate diagnosis and management of the patient for that case. Students meet three times during the week to advance their understanding of the case. Two of these sessions are facilitated by Faculty members and the third session involves interpretation of additional clinical information about the case which is supplied after the initial diagnosis has been made. As a result of the widened access policy, it was proposed to scaffold student learning through the week by modifying the purely problem-based approach through 2 mechanisms: by scheduling a maximum of 6 lectures during the week and by supplying pre-printed “learning topics” which contain the core information necessary to manage the case.

Using this problem-based approach, it is evident that teaching is horizontally integrated into body system blocks (e.g. musculoskeletal, endocrine, respiratory) rather than individual (discipline specific) subject courses (e.g. physiology, pathology, pharmacology). Students encounter the individual disciplines only insofar as they pertain to the case. Thus, the teaching of basic pharmacology, fundamental knowledge for rational prescribing, is integrated into the curriculum of GEMP I and II as core lectures and learning topics essential for concluding the weekly delivered case (See more detail on this in 2.3.3.1 below).

In GEMP III and IV, the small-group learning structure is preserved, but the focus shifts from computer-delivered cases debated in a home-room to development of actual clinical competence in the wards. Groups of students rotate through different clinical departments where they participate in patient management. Whilst the emphasis remains on student self-learning, clinicians in the wards facilitate learning opportunities. The Department of Pharmacology has little formal input into these 2 years of study, since most of the therapeutics teaching is carried out by clinicians in the ward situation. With approximately 200 students per class, not all students come into contact with all patients during their

different rotations. The nature of such clinical teaching is thus more opportunistic than following an individualized course in rational prescribing.

In addition, there are three vertical themes which run in parallel to the basic and clinical sciences (BCS) blocks throughout the 4-year GEMP programme. These include: the “patient-doctor” theme (PD) which explores psychosocial dimensions involved in clinical consultations; the “personal and professional development” theme (PPD) which emphasizes ethical and professional behaviour; and the “community-doctor” theme (CD) which has a sociological focus on public health issues. Taken together, these themes are intended to inculcate a biopsychosocial approach to medical practice in order to promote a holistic approach to patient care.

Assessment of all four vertical strands of the curriculum is integrated, relying on a mixture of multiple choice, short written answers, computerized short answer questions, and clinical/practical tests to demonstrate the students’ competence. Students are usually tested at the end of every body-system block and they are also required to complete two “inter-block” integrated examinations, one at the end of GEMP II and one on completion of GEMP IV. The integrated examination at the end of GEMP IV is intended as an “exit-level” examination to assess competence to practice. There are no specific pharmacology or prescribing skills individual assessments.

Following graduation, students are required to complete one year’s internship in a supervised hospital and two mandatory years of community service at a government-determined posting. In these positions, they are required (and legally entitled) to prescribe for all patients.

2.3 Curricula for Developing Competence in Rational Prescribing Skills

2.3.1 International Policies

Together with the University of Groningen, the World Health Organization (WHO) Action Programme on Essential Drugs devised a 6-step guide as a normative model for therapeutic reasoning to achieve rational prescribing (De Vries *et al*,1994). According to this model, the student should attain the following competences in order to prescribe appropriately:

Table 2: World Health Organization Six-Step Model of Rational Prescribing

Steps	Description
Step 1	Define the patient's problem
Step 2	Specify the therapeutic objective
Step 3a	Choose the standard treatment
Step 3b	Verify the suitability of the treatment
Step 4	Start the treatment
Step 5	Give information, instructions and warnings
Step 6	Monitor (and stop?) treatment

Based on this WHO model, The UK Medical Schools Council Safe Prescribing Working Group (2008) produced a consensus list of competencies that a Foundation Year 1 doctor (intern) should know how to accomplish by their first day of practice with regards to prescribing. The list includes:

The ability to

1. Establish an accurate drug history.
2. Plan appropriate therapy for common indications.
3. Write a safe and legal prescription.
4. Appraise critically the prescribing of others.
5. Calculate appropriate doses.
6. Provide patients with appropriate information about their medicines.
7. Access reliable information about medicines.
8. Detect and report adverse drug reactions.

Maxwell and Walley (2003) published a core curriculum for “teaching safe and effective prescribing in UK medical schools” which makes the above competences accessible to medical students. They discuss five major curricular issues that influence development of the knowledge, skills and behaviours required of doctors to prescribe rationally. These include:

- *Development of a Student Formulary*

A list of about 100 commonly used drugs, representative of the major drug classes, used to treat common illnesses should be identified. This list could be used by students to

prioritize their learning and to help them develop a framework for the rational usage of drugs in clinical practice.

- *Delivery Structure of the Curriculum*

The authors stress that attainment of rational prescribing competence can occur within “traditionally” delivered curricula; those which teach individual disciplinary knowledge, as well as within “integrated “ curricula; where barriers between subjects have been removed. They note, however, that in more integrated medical courses there is an absence of “protected time” dedicated to development of rational prescribing skills and thus there may be practical difficulties in integrating sufficient learning opportunities across different modules over several years.

- *Leadership*

The point is made that in order to achieve rational prescribing skills in graduates, sufficient and appropriate learning opportunities should be offered within the medical curriculum. A “champion” is necessary to foreground rational prescribing skills within the curriculum and coordinate other aspects of teaching to support development of these skills.

- *Teaching and Learning Styles*

The skill of prescribing rationally involves application of fundamental disciplinary knowledge to an individualized practical situation. Maxwell and Walley (2003) assert that active learning on the part of the student is essential in mastering this skill. They note that in earlier years of the medical curriculum such active exercises can take the form of therapeutic case discussions, whilst prescribing can be foregrounded in the later years during clinical attachments. They list a host of learning opportunities that could be employed at any level to enhance development of rational prescribing skills e.g. review drug sheets, participate in clinical management discussions, self-assess knowledge about core drugs, assess colleagues prescriptions for drug interactions, write up case reports, communicate prescribing decisions to patients, critically analyse clinical trials, search for information about new drugs, and so on.

- *Assessment*

“Assessment drives learning and consolidates the acquisition of core knowledge and skills.”

Maxwell and Walley link this reasoning with the mandatory requirement for a robust assessment of prescribing competence. They claim that the assessment should be verified by external examiners and professional accreditation bodies, and that it should be sufficiently sensitive to identify students who have poor knowledge about drugs and who are inadequately prepared to prescribe.

With regard to integrated curricula, they specifically comment that a separate assessment of prescribing competence is necessary.

“Even within an integrated assessment scheme, there should be a clear, identifiable, and robust component devoted to the knowledge and skills that support the prescribing of drugs. Furthermore, it is inappropriate that any student should be able to compensate for a poor performance in prescribing or therapeutics with good performances in other assessments.”
(Maxwell & Walley, 2003)

They note that it is important to test the knowledge, skills and attitudes that are identified in the core curriculum in a manner that is relevant to early clinical practice and comment that although essays and multiple choice questions can assess knowledge, understanding and application, practical skills are best assessed by an objective-structured clinical examination (OSCE).

Richir and colleagues (2008) review the need for therapeutic reasoning skills in developing rational prescribing competence. They conclude that context-learning is an effective approach to developing such skills – where they define the real-life clinical setting as the most extreme form of context learning. Other less concrete examples of context learning include role-playing sessions with standardized patients in a simulated practice setting, solution of written patient problems and patient demonstrations during lectures. These activities assume that adequate curricular time will translate to students’ recognition of the limits of the skills to be tested, their acknowledgement of the importance of rational prescribing competence and their subsequent motivation to participate in the learning experiences.

“.....the clinical pharmacology and therapeutics curriculum should be a visible part of the medical curriculum and that students must know, from the beginning, the required level of competence when they graduate” (Richir *et al*, 2008)

The process of diagnostic reasoning (achieving competence in step 1 of the WHO schedule) is the focus of clinical teaching in many medical schools (Richir *et al*, 2008) and has been investigated extensively (for reviews see Norman, 2005; Norman *et al*, 2007 and Eva, 2005). In many curricula, however, little formal time is devoted to development of therapeutic reasoning; that step in clinical reasoning that pertains to choice of therapy (and corresponds to steps 2-6 in the 6-step model of rational prescribing) (Norman, 2005; Barber *et al*, 2003). Reasons for this disparity in emphasis are elusive. It is acknowledged that changing circumstances in the practice of medicine worldwide, including the technologically-driven exponential growth in biomedical and clinical knowledge has mandated a curricular shift from factual-based programmes to those which prepare students to locate, critically appraise and apply new information to clinical practice (Jackson & Calman, 2006).

Professor Ralph Edwards (2008), the Director of the WHO collaborating centre for international drug monitoring, theorizes that pharmacology and therapeutics are considered such factually dense subjects that they are prime targets for reduction in medical curricula – to the detriment of rational prescribing skills. The dichotomy is that as the number and nature of medicines available for patient care proliferate, so the quantity (and possibly quality) of prescribing tuition decreases (Maxwell *et al*, 2002). In addition, the impact of globalization on medical marketing, specifically with regard to the availability of medical information via the internet, has altered the professional standing of the doctor with regard to prescribing authority (Talbot, 2005). Many modern medical curricula have attempted to address these issues by reducing the factual burden of drug information in the curriculum and improving skills such as data sourcing, evidence-based drug decision-making and communication (GMC, 2003; Sweeney, 1999, Candler *et al*, 2007).

2.3.2 Local Perspectives

Harries and her colleagues (2006) also devised a list of competencies based on the WHO models and modified to reflect South African needs. These include:

TABLE 3: SOUTH AFRICAN PRESCRIBING OUTCOMES
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Skill	Skill description
1	Selecting appropriate treatment
2	Using guidelines to guide prescribing
3	Medical literacy: understanding package inserts and the South African Medicines Formulary
4	Counseling
5	Critical assessment of company literature
6	Detection, monitoring and treating drug-related adverse reactions
7	Interpretation of drug levels/ monitoring and using these to guide prescribing
8	Dosage calculation
9	Avoiding/ combating polypharmacy

No formal research has yet been published on South African curricula which could deliver these objectives.

2.3.3 The Prescribing Curriculum within the GEMP

Rational prescribing is a blended skill which requires input from many diverse bodies of knowledge in order to inform the judgments which produce competence. Since diagnostic skill is not the focus of this project, it will be excluded from the discussion of factors which contribute to making rational prescribing decisions. Thus, assuming a correct diagnosis, the doctor has then to recruit from many skill-sets in achieving a rational prescription. Factors contributing to rational prescribing include: effective communication; psychological recognition of patient culture and needs; knowledge of national and local guidelines, protocols, and policies; correct documentation, auditing, monitoring and evaluating prescribing practice; economic considerations of budget and cost effectiveness; legal implications including liability and indemnity, awareness and reporting of fraud; ethical use of medicines, professional accountability and, in the broader sense of public health, duty to patients and society. Curricular elements designed to impart this knowledge and skills are located in the PD, PPD and CD vertical themes which run throughout GEMP I to GEMP IV.

In addition to these factors, two major subjects which provide the disciplinary knowledge bases that underpin rational prescribing choices are basic pharmacology, delivered in GEMP I and II and clinical therapeutics, delivered in GEMP III and IV.

2.3.3.1 The Basic Pharmacology Curriculum

Formal teaching of pharmacology within the GEMP occurs in years I and II of the programme. Fifty lectures are delivered over the two-year period; however, 21 of these lectures are delivered within the first 4 weeks of GEMP I as part of the Preliminary Concepts in Medical Science (PCMS) block. This block, containing approximately 120 lectures, is intended to provide foundation knowledge in pharmacology, microbiology, pathology, immunology, bioethics, information retrieval and problem-solving strategies prior to commencing the integrated problem-solving curriculum. Although 21 pharmacology lectures are delivered in this block, only 14 of these are preliminary concepts lectures. The remaining 7 lectures are delivered at this point since they are considered essential information by the Division of Pharmacology, however there is no appropriate case within the GEMP I and II curriculum where they can be attached. Of the remaining 29 pharmacology lectures, 13 are delivered in GEMP I and 16 in GEMP II, out of a total of approximately 180 lecture deliveries in GEMP I and 210 lecture deliveries in GEMP II. Thus, in quantitative terms, approximately 17.5% of the PCMS lectures are delivered by the pharmacology department, as opposed to 7.2% of GEMP I lectures and 7.6% of GEMP II lectures.

“Learning topics” are included in the students’ weekly printed “learning packs” which are intended to supply core information essential in managing the problem under discussion. In GEMP I, there are 8 learning topics delivered by the pharmacology department out of an approximate total of 240 for the year (3.3%) and in GEMP II, 21 out of approximately 265 learning topics are pharmacology-based (7.9%). There is also one practical demonstration session. This preceding information is summarized in the following table:

TABLE 4: PHARMACOLOGY CONTRIBUTION TO GEMP I AND II TEACHING DELIVERIES

BLOCK	DURATION (weeks)	NUMBER OF LECTURES	NUMBER OF LEARNING TOPICS	COMMENTS
GEMP I Preliminary Concepts in Medical Science (PCMS)	4	21	-	There are approximately 120 lectures delivered in this initial block – and no learning topics. Pharmacology lectures included here comprise introduction to the subject (14 lectures) as well as topics which are not included anywhere within the GEMP I and II curriculum but are considered “core knowledge” by the Department of Pharmacology (7 lectures)
Life on the Street (LOTS)	5	-	2	
Cardiovascular (CVS)	6	6	3	
Respiratory	7	4	2	In addition to the lectures and learning topics, 1 demonstration session is included here
Renal	5	2	-	
Haematology (HAEM)	6	1	1	
GEMP II Endocrine	5	4	2	
Musculoskeletal	6	5	2	
Gastrointestinal GIT and Nutrition	7	3	6	
Reproduction	6	1	8	The lecture in this block was inserted at the request of students – to explain material from the learning topics
Neurosciences	9	3	3	
TOTALS	66	50	29	

As a “service” department, the Division of Pharmacology was given a curricular mandate by the GEMP Faculty to deliver lectures containing “core” pharmacology pertaining to medicines proposed for the alleviation of the weekly theoretical problems. Whilst the systems-based curriculum structure of GEMP I and II was based on a PBL course from a Sydney medical school, the individual Wits PBL cases were designed by a committee of

experts to reflect fundamental medical knowledge in the training of South African doctors. Given this perspective, the definition of “core” pharmacology was based on the South African National Essential Drugs List (EDL), developed by a specialist committee under the auspices of the Government (Department of Health,1996). The EDL is a restricted list of medicines deemed necessary and affordable to treat the majority of medical conditions that are prevalent in South African Public hospital practice, and as such, forms the basis for curricular choices about which drugs should be foregrounded within the GEMP.

2.3.3.2 The Clinical Therapeutics Curriculum

In GEMP III and IV, student groups work sequentially through different clinical departments where they observe and participate in patient diagnosis and management. Clinical pharmacology is discussed in relation to therapeutic decision-making and students learn through both group and individual interactions. In this arena they are exposed to what Bernstein (2000: 114) terms the “regulative discourse” the rules of appropriate conduct, character and manner of prescribing medicines by modelling on doctors’ behaviour in the wards. Beck and Young (2005: 188) note,

“that professional training typically involved more than the imparting of specialist expertise; it also involved intensive socialization into the values of a professional community and its standards of professional integrity, judgment and loyalty”.

With respect to prescribing skill, this implies that not only must students develop a knowledge base in pharmacology and clinical therapeutics, but they also have to acquire honest, ethical, reliable and trustworthy behaviour with respect to handling medicines.

Table 5: Ward Rotations in GEMP III and GEMP IV

Table 5: Ward Rotations in GEMP III and GEMP IV							
GEMP 3	Obstetrics	Acute and Peri-Operative Care:	Surgery	Mixed I	Medicine	Paediatrics	Mixed II
		Emerg Med (Clin) Forensic Med Anaesthetics Trauma		Family Med Psychiatry ENT			Urology Ophthalmology Public Health
GEMP 4	Medicine	Mixed	Paediatrics	Gynaecology	Integrated Primary Care (IPC)	Surgery	Psychiatry
		Medicine Orthopaedics					

Having summarized the content and form of the intended prescribing curriculum, I now discuss a theoretical framework to support enquiry into how students experience the actual curriculum, and how rational prescribing competence is assessed in the exit-level examination.

2.3.3.3 Theories of Curricular Delivery

Blackledge and Hunt (1985) comment that one of Bernstein's skills was to classify and label segments of the educational process which allowed others to view clearly his constructs and theories. Bernstein (1977) initially discussed the educational process from three major perspectives: What the academy defines as valid knowledge Bernstein termed "the curriculum". "Pedagogy" he defined as those activities which bring about valid transmission of the knowledge, and he delineated "evaluation" as the realisation of the knowledge transmitted. Since Bernstein was a sociologist, his work concerned the loci of power and control in the educational process and his frameworks can be used to view these tensions.

- *Classification and Framing*

Bernstein (1977) developed conceptual tools with which to explicate aspects of the educational process. When viewing the curriculum, Bernstein noted that units of curricular time delivered through the day i.e. the "disciplinary" contents of the curriculum exist in relation to each other. He called this relationship "classification": When there were clear and obvious boundaries that separated one section of content from another, this was termed "strong" classification. Within the context of medical education, individual disciplinary knowledge is strongly classified since there are clear rules which insulate one discipline from another (for example, it is simple to distinguish anatomy from pharmacology through recognition of the definitions of valid knowledge within those disciplines). This gives rise to the metaphor of delivery of disciplinary medical knowledge as "silos" within the curriculum, or as Bernstein called it, a "collection code", where knowledge in the curriculum is strongly classified. Conversely, when the boundaries between contents are vague or indistinct, classification is said to be "weak". For example, if the topic under consideration is "irregular heartbeats", content units could blend aspects of anatomy, physiology and pharmacology in explaining facets of heart functioning. In this example, there is weak classification between the contents, since the aim is to integrate the knowledge towards solution of the problem. Where the strength of classification is reduced, Bernstein termed this an "integrated code". Proponents of integration of medical curricula (Harden & Stamper, 1999) claim that since

real-world medical practice is trans-disciplinary, learning in an integrated fashion contextualizes the information and makes it easier for students to construct their own knowledge schema. Linkage of individual disciplines should thus assist problem synthesis and solution in rational 23eorganizat.

The concept of “framing” relates to the degree of control in what curricular content is transmitted. In Bernstein’s words:

“Thus, frame refers to the degree of control teacher and pupil possess over the selection, organization, pacing and timing of the knowledge transmitted and received in pedagogical relationship.”(ibid. p89).

Where framing is strong, the participants have little control; where framing is weak, the control is concomitantly greater. Therefore, the intention of enabling a student-centred pedagogy to predominate in the GEMP implies weak framing, where students would have greater control over the selection, sequencing, and pacing of rational prescribing knowledge.

- *Singulars and Regions*

Turning now to the actual structure of the knowledge, Bernstein (2000:52) makes the distinction between strongly classified academic disciplines, which he called “singulars” and “regions” where education is oriented to a field of practice (2000:54). For singulars, there are strong boundaries between what is recognised as relevant disciplinary knowledge to that singular, and other external knowledge. In a region, however, knowledge is “recontextualised” i.e. selected from singulars then interpreted in relation to the relevant practical field, and classification is therefore weaker. The implications for curricular critique here are that the decision of “what counts as valid knowledge for rational prescribing” can depend on the disciplinary perspective of who makes that decision: In the context of Wits Medical School, the recontextualising principle can be officially applied by the CHSE (from their perspective of where these skills fit in relation to the rest of the curriculum), or by the division of pharmacology (from the perspective of what counts as the essential knowledge structure which will allow meaningful application to practice) or by the clinicians in the wards (from the contextual field of applied practice). Depending on predominance in the tensions between the various stakeholders, students need to be able to recognize the structure of the knowledge required, and then produce or “realise” the necessary outcome when evaluated.

- *Knowledge Structures*

In terms of actual knowledge structures, Bernstein (2000: 157) differentiated between two “fundamental” forms of discourse, which he termed “horizontal” and “vertical”. Horizontal discourse expresses everyday, “commonsense” knowledge, which is “local, segmental, context dependent, tacit, multilayered, often contradictory across contexts but not within contexts”. In contrast, a vertical discourse “takes the form of a coherent, explicit, systematically principled structure, hierarchically organized, or it takes the form of a series of 24eorganizat languages”(2000:160). For example, many people know that aspirin can be used to treat a headache. This is an example from the horizontal discourse, since knowing one common use of aspirin does not give access to other, more specialized information about the drug, or the use of medicines in the treatment of other ailments. This type of knowledge, gained in a specific context, is not always applicable to other situations. In comparison, knowing the mechanism by which aspirin exerts its effects on the body permits conclusions about other indications it can be used to treat, -who would benefit from taking the drug, who should not take the drug, which drugs should you avoid when taking aspirin – this is an example of a hierarchically organized vertical knowledge structure, within the realm of the formally acquired vertical discourse. In contrast, although still within a vertical discourse, horizontal knowledge structures are usually explained by considering the humanities (e.g. sociology), where different theories follow their own rules, but cannot be hierarchically integrated into one overarching principle or hypothesis.

- *Cumulative Learning and Conceptual Coherence*

Maton (2009:45) clarifies how these structures develop over time:

“Hierarchical knowledge structures develop through new knowledge integrating and subsuming previous knowledge, whereas horizontal knowledge structures develop through adding on another segmented approach or topic area.” (Maton, 2009:45)

Maton extends Bernstein’s theory of knowledge structures to include curriculum structures which deliver this knowledge, and the eventual pathways by which students develop competence: For hierarchical curriculum structures, each new unit of content builds on previously delivered content such that students’ understanding develops by integration of this new material into a system of meaning, allowing the development of principles. Maton terms this “cumulative learning”; the situation “where new knowledge builds on and integrates past knowledge”. He claims that it is desirable to design curricula that facilitate cumulative learning since this enables students to “transfer knowledge across contexts and build knowledge over time”. This is akin to Muller’s (2009:217) idea of “conceptual coherence

features” in a curriculum where the vertical structure of the knowledge base must be made apparent to enable recognition and realisation of what counts as knowledge in the discipline.

- *Segmented Learning and Contextual Coherence*

In contrast, Muller (2009:217) discusses a mode of delivery which “aims to produce knowledgeable professionals, and is thus more oriented to the demands of the workplace” as a “contextual coherence curriculum”. He notes that such a curriculum is less constrained by sequencing and can be delivered in modules or segments. This resonates with Maton’s extension of Bernstein’s knowledge structures to curricula: As previously stated, a horizontal knowledge structure (Bernstein, 2000:161) (still within the vertical discourse of specialised knowledge production) is “a series of specialised languages with specialised modes of interrogation and criteria for the construction and circulation of texts.” In horizontal curriculum structures, units are delivered by “segmental aggregation” which results in “segmented learning”, which is context-dependent and thus is not transferrable (Maton, 2009:45). Segmented learning, as defined by Maton is “where students learn a series of ideas or skills that are strongly tied to their contexts of acquisition”. This type of learning constrains transfer of knowledge to other contexts and restricts refining of understanding to reach a more integrated plateau of understanding.

- *The Rational Prescribing Curriculum*

Applying the theories of Bernstein, Muller and Maton to the delivery of the rational prescribing curriculum, it is apparent that the pedagogical route of delivery influences the structure of both the knowledge and the curriculum: In GEMP I and II, the planned curriculum mandates development of core knowledge of the discipline of pharmacology, so that this knowledge can be utilised in clinical therapeutics decision-making during GEMP III and IV. Pharmacology has a vertical knowledge structure which relies on development of principles in the integration of empirical phenomena. It thus requires a curriculum with conceptual coherence, where the sequence of delivery is important since the aim is cumulative learning where later knowledge subsumes previous elements in development of understanding. However, the mode of curricular delivery in GEMP I and II is PBL, where content is learned in relation to the specific context of that week’s problem. Muller explicates the problem concerning the use of PBL in medical curricula:

“Consequently, they design the curriculum in terms of external contextual coherence instead of internal conceptual coherence. This flouts the sequential requirements of the vertical parent knowledge structures..... and students end up with gaps in their knowledge” (Muller, 2009:219)

He emphasises that if the vertical “spine” of the parent discipline is obfuscated such that the conceptual progression is either invisible or out of sequence

“– then learning is put at risk in one of two ways: either crucial conceptual steps are missed, in which case learning stops; or vital chunks of knowledge are missed, leaving knowledge gaps.” (ibid)

Thus, in the development of rational prescribing skills, if a student loses sight of the primary structure of the discipline of pharmacology, disciplinary knowledge can then seem as unnecessary, complicated detail with little impact on developing competence in clinical practice. The resultant segmented learning is strongly associated with the context of the week’s problem and cannot be transferred to other weeks or between body-system blocks in the curriculum. This lack of integration of disciplinary knowledge subjectively increases the volume of what has to be learned – since the contextual information is reduced to “lists” which bear no relation to each other and therefore cannot be learned in relation to one overarching principle. The apparent increase in volume has implications for the approaches to learning which students can then adopt.

- *Deep and Surface Approaches to Learning*

The work of Marton and Saljo (as quoted in Gibbs, 1992) on student approaches to learning divides students’ tactics into two main areas: Those of surface and deep approaches. When students take a surface approach, according to Entwistle (1987), their intention is to complete set work requirements, rather than to understand content. They achieve this by focusing on discrete elements and memorizing information as needed. They treat tasks as external impositions, fail to distinguish principles from examples and remain generally unreflective about purpose or strategies. In contrast, students who adopt a deep approach do so with a view to understanding. They interact vigorously with content and are able to relate new ideas to previous knowledge, concepts to everyday experience and evidence to conclusions. Thus, they achieve cumulative learning. It is important to note that these approaches do not denote personality types – rather they are approaches which students take towards their work – and students may change their approach in different work situations (Ramsden, 1992).

According to Gibbs (1992), teaching in the positivist mode can lead to students adopting a surface approach to learning since memorization and rote learning is rewarded in the assessment, there is little feedback interaction on progress and the lecturer’s focus is on

covering the curriculum. There are implications here for the teaching of pharmacology in GEMP I and II which I will expand on in the following section. It has been noted (Trigwell, Hazel and Prosser, 1996) that it is much harder to achieve deep learning in science at a university level, since most science curricula are content-heavy and require assimilation of much fact-based information. The modification of the Wits MBChB curriculum was an attempt to shift learning approaches towards integrative understanding rather than fact collection, however the contextual nature of PBL contrarily may have influenced students towards surface learning approaches.

It would thus seem that curriculum planning directly affects the type of approach taken by students: Heavy workloads with an emphasis on contextual coverage, assessments that reward students for recalling isolated information and insufficient choice in curricula have all been implicated in promoting surface learning (Newble & Entwistle, 1986)

2.3.3.4 The Division of Pharmacology in the School Of Therapeutic Sciences

At this point, I introduce a description of the development of the division of pharmacology as a “service” provider in delivering pharmacology knowledge to medical students, whilst remaining outside of the structures and philosophies of the CHSE. Traditionally, medical pharmacology was considered a para-clinical discipline, which connected the basic science of drug action to clinical therapeutics skills. Imposing this artificial divide between basic science and clinical medicine allowed teaching of pharmacology with two distinct orientations; initially as fundamental science within a pre-clinical curriculum, and then, in a more applied sense, during the clinical years.

Within the University, partitioning of the science led to development of expertise through two distinct routes (initially within one department), with staff recruitment, journal publications and funding becoming polarized to reflect scientists controlling the production of basic pharmacological knowledge and clinicians responsible for applied research and furtherance of clinical pharmacology skills. Applying Muller’s (2009:216) terminology, there was a tension between the more conceptual knowledge base of the scientists and the more contextual knowledge base of the clinicians. Subsequent restructuring within the University compounded with stringent financial pressures resulted in contraction of the department to a Division excluded from the School of Clinical Medicine, and administratively allied with the

teaching of ancillary patient therapy. This reorganization caused a dramatic reduction in academic staff which, in line with worldwide trends of diminishing numbers of clinical pharmacologists (Maxwell & Webb, 2006), presaged the collapse of clinical pharmacology within the Division.

The resultant ascendance of basic pharmacology as the dominant knowledge form had important implications for recontextualisation of the discipline with respect to teaching students. Firstly, as Middleton (2008) notes, the reward structures within Universities are commonly linked to publication of research work as evidence of extension of the disciplinary knowledge base. In our case, economic survival of the Division and individuals' career trajectories within the University depended on publishing novel research (the activity valued by the Academy) and the teaching of students was viewed as an unrewarding, often problematic burden. Secondly, the traditional epistemological approach in the division was strongly positivist, where knowledge was considered an external collection of information, which was transmitted as a body of facts from the teacher to the student. This approach reflected a belief in reality as mechanistic, where parts of the syllabus could be taught in a decontextualised manner, separated from each other, and where the relationship between cause-and-effect was explicit. Information was added to the body of knowledge either through induction (experience) or deduction (experimentation) (Shepard, 2000:5). This resulted in a factually dense pharmacology curriculum in which academic achievement was graded comparatively by the amount of specific information remembered by a student.

It is against this background that I now review the contribution of the division of pharmacology towards delivery of a curriculum intended to facilitate development of rational prescribing skills in Wits medical students. Here, the primary pedagogic aim was to produce competent professionals rather than laboratory scientists, and thus basic pharmacological knowledge had to be recontextualised (to use Bernstein's term) to coincide with the selection, sequencing and pacing of delivery of individual PBL cases within the body-system blocks. The locus of curricular control, whilst formally residing with the Faculty Undergraduate Committee as before, was now interpreted and enforced by the Centre for Health Science Education (CHSE), rather than from within the division of pharmacology. In addition, staff members within the division were expected to contribute towards the overall curriculum delivery (with regard to facilitation of PBL sessions and writing of learning topics) rather than merely conveying their pharmacological information in the form of didactic lectures. Lastly, the control of both the content and methods of assessment was given

over to the CHSE, with a concomitant reduction in assessment of pharmacological knowledge content and increase in time-demands on the staff to mark different types of examination questions. I will explore some of the implications of these changes of influence in discussion of the findings of this study.

CHAPTER 3: LITERATURE REVIEW

The main focus of this study is to ascertain how students are assessed on rational prescribing competence at the conclusion of their formal medical school training and to gain insight into students' perceptions of prescribing. In this literature review I therefore examine previous research into assessment of prescribing competence and research frameworks for analysis of examinations. In addition, earlier studies on student perceptions of prescribing are reviewed.

3.1 Prescribing Competence versus Professional Proficiency

In the context of medical school, therapeutic competence is defined as the ability to prescribe drugs rationally under observed or examination circumstances. Competence should be distinguished from performance, which is the ability to prescribe rationally in daily life circumstances (without observation) (Epstein, 2007). Whilst performance can only be adjudicated *post facto* by prescription audit or clinical review, competence may be determined through a variety of testing instruments, some of which are noted in section 3.2 below. Rethans (1990) and his colleagues conducted a study on 36 doctors, comparing examination competence with actual practice performance using incognito standardized patients. They concluded that performance and competence should be considered as distinct constructs, since competence scores were greater than performance adjudication. However, assessment of competence in an examination situation has predictive value for performance in actual practice when factors such as consultation time and efficiency are taken into account.

3.2 Measuring Prescribing Competence

In "*Tomorrow's Doctors*", the GMC stipulates that prescribing and therapeutic skills are important outcomes of medical training. "Graduates must know about and understand... the effective and safe use of medicines as the basis of prescribing" (item 16c) (GMC, 2003). With the aim of supporting British medical schools to achieve these outcomes regarding prescribing, the British Pharmacological Society published guidelines as to how the relevant knowledge, skills and attitudes could be incorporated into courses. Amongst the principal recommendations was one relating to assessment, "that there should be an identifiable and

robust assessment of prescribing and therapeutics” (Maxwell & Walley, 2003). Although this seems obvious, many medical schools following integrated curricula do not have an identifiable “prescribing” component in their assessment structure, and students can pass their exams overall, without demonstrating specific competence in prescribing (Richir *et al*, 2008).

One of the challenges in assessment of prescribing competence is ensuring the validity and reliability of the test – since competence encompasses knowledge, skills and attitudes. Thus, a truly valid assessment should employ constructs to test all of these domains, while a highly reliable test should produce the same marks even when marked by different examiners, or students should score similarly (all other factors being equal) if administered the test at different timepoints (Mouton, 1996:144).

Rational prescribing skills have been adjudicated by varied methodologies. Examples include patient problems/ treatment plans (de Vries *et al*, 1995, Hassan *et al*, 2000) where students have to devise a written case management plan in response to a paper-based (hypothetical) case. This method tests problem-solving capability, ability to apply knowledge and clinical reasoning skills, but is limited by inter-rater variability (between different examiners) and the time-consuming nature of accurate marking. Verbal order transcription tests have been used (Garbutt *et al*, 2006), where students were read 10 medication orders for a patient and were instructed to fill in a patient chart. This format can test knowledge and practical skills, however it is labour intensive to administer and mark. Case prescription audits (Akici *et al*, 2005) can be used for either formative or summative assessment, where the student presents a case and suggests a course of treatment. For formative assessment, the examiner can immediately respond to the student’s presentation. For a summative assessment, the examiner would mark the student’s competence with reference to a checklist. As with previous examination strategies, this is a labour-intensive method that is subject to inter-rater inconsistency. The objective structured clinical examination (OSCE) is an extension of a case-prescription audit (Scobie *et al*, 2003). In a study conducted by Langford and his colleagues (2004), students participated in a therapeutics OSCE with 6 active stations and a rest station. Two complete sets of stations ran in parallel, thus 14 students were examined at one sitting with 6 minutes allocated per station. The OSCE examined aspects of therapeutics to highlight knowledge application, clinical skills and practical abilities. This method of examination, however, it is an extremely labour-intensive endeavour, both in staff requirement (presence) and training as well as marking of the generated scripts. Also, from the student’s point of view, the timing and setting reduce the “real-life” aspect of questions.

The most commonly used method for assessment of rational prescribing skills in medical schools remains the written multiple-choice question (MCQ) (Stupans, 2006). Although MCQ-based examinations are time-consuming to set, they can objectively test large numbers of students with minimal staff involvement. Using this method, a broad range of knowledge can be tested within a short space of time, which contributes to high reliability (or reproducibility) of this testing method (McCoubrie & McKnight, 2008). Validity can also be robust for a well-designed MCQ, since this method can be used to test a range of skills such as interpretation, synthesis, and application of knowledge rather than purely testing factual recall (McCoubrie & McKnight, 2008). They cannot, however, assess unprompted recall, communication skills and technical skills (Maxwell *et al*, 2007).

The advantages of high reliability and validity, as well as ease of administration and marking should be balanced against the effect of “cueing” (Epstein, 2007), the phenomenon of a student answering the question by recognizing the correct option, but who could not have answered it without prompts. This effect can be minimized by the use of extended matching questions (discussed below in point 3.2.2).

I will discuss 2 variations of MCQs, Single-best answer or A-Types in section 3.2.1 below and Extended-matching questions (EMQs) or R-Types in section 3.2.2.

3.2.1 Single best answer MCQs (A-types)

The main advantage of A-Type, single-best answer questions is their alignment with clinical problem-solving where “best” choice of patient care must be selected from a number of similar options. Face validity with authentic therapeutic choices is therefore high. In addition, McCoubrie and McKnight (2008) claim that single-best answer questions are more straightforward to understand (particularly when compared with MCQs with multiple true/false statements). Thus, for those candidates whose first language is not English, A-type MCQs are a better test of their knowledge base and application, rather than interpretive English skills. This type of written question has therefore become the standard in high-stakes medical examinations (Epstein, 2007), for example, from 2009, the Royal College of Radiologists will use this format exclusively in their exit-level (qualifying) written examinations (McCoubrie & McKnight, 2008)..

3.2.2 Extended-matching questions (EMQs) or R-Types

In a review of the advantages of extended matching (R-Type) questions, McCoubrie (2004) notes that they are a good vehicle for testing application and integration of knowledge, clinical decision-making and factual recall. Also, this type of question facilitates wide sampling from different areas of the curriculum in a format which can be answered in a short time, which increases the reliability and validity of the examination method (Vyas & Supe, 2008).

In a study to determine the utility of EMQs in a medical school in Belgium, Beullens and his colleagues (2002) collected a bank of 900 EMQs from 10 medical specialties within the faculty. Two hundred and fifty one final-year students answered the questions in serial batches of 100. Statistical analysis confirmed the use of EMQs as feasible, valid and reliable for exit-level examinations in medical education (Beullens *et al*, 2002).

3.3 Classification of MCQ statements within a hierarchy of educational objectives

3.3.1 Bloom's Taxonomy

Within the medical education literature Bloom's taxonomy has been used to quantify levels of learning that students are asked to demonstrate in examinations – including multiple choice examinations. In 1991, Miller and his colleagues used the taxonomy to show that the majority of test items in a series of psychiatry examinations at the University of Texas required simple recall rather than “higher order” cognitive processes such as understanding, application, analysis or evaluation. Palmer and Devitt (2007) continued in this provocative vein, reporting that in a series of final medical examinations at the University of Adelaide, the answering of multiple choice questions (MCQs) was found to require higher-order cognitive processes than modified essay questions (MEQs). They attribute this unexpected result to poor construction of MEQs as a result of lack of experience of authors.

A further paper which uses Bloom's Taxonomy to challenge current views addresses the issue of assessing “factual minutiae” rather than critical thinking skills in the American Medical College Admission Test (MCAT) (Zheng *et al*, 2008). Freeman and his colleagues show that the MCAT does assess higher order cognitive processes and calls for experienced instructors to create and share MCQs that test knowledge application, analysis and synthesis.

Finally, in an extension of their work on assessment of student prescribing practices, Harries and Botha (2007) utilized the cognitive dimension of Bloom's taxonomy to classify the level of cognitive challenge posed by the questions in their prescribing test and analysed student performance in relation to Bloom's categories. Although most of the results followed the unsurprising pattern of declining student achievement the higher the cognitive demand of the question, they document an anomalous finding; that for the short answer questions, students scored less for questions deemed to require comprehension than they scored for questions requiring application (a higher order skill, which assumes knowledge and comprehension). The researchers postulate that short-answer questions requiring demonstration of comprehension necessitated "sophisticated writing skills" in order for responses to meet the criteria necessary to achieve good marks. In contrast, problems involving application entailed utilising specific clinical details within a stated context and thus required much shorter, direct answers. The implication here is that question design which relies on English proficiency to demonstrate comprehension rather than disciplinary knowledge compromises validity and should be avoided.

3.3.2 The SOLO Taxonomy

The SOLO taxonomy has been used to investigate the relationship between assessment results and styles of learning in second year medical students (Reid *et al*, 2007). Although marks correlated positively with deep and strategic approaches and negatively with surface approach the associations were less consistent than anticipated. The authors postulate that possible reasons include the drive to test basic (core) material, the use of questions that may limit students' scope of expression and markers' ability to detect a deep approach. They conclude that assessment influences students' learning approaches and that Faculty should take this into account when setting course objectives and assessments.

Pandey and Zimitat (2007) used the SOLO taxonomy to rate the quality of student assessment in anatomy and to compare this with student approaches to learning. They conclude that the learning approaches adopted by students correlate positively with examination outcomes as rated by the SOLO taxonomy.

3.4 International Student Perceptions of Prescribing Competence

Student comment and opinion have been actively sought in the controversy over student preparedness to prescribe on graduation and the incidence of prescribing errors among junior doctors. Views from medical students and interns in individual centres in the USA (Garbutt *et al*, 2005), Scotland (Han & Maxwell, 2006) and Australia (Coombes *et al*, 2008a) have emphasized students' underpreparedness to prescribe on graduation. All three studies collected information via written questionnaires voluntarily submitted by participating medical students or junior doctors. Thematic clusters of questions were surprisingly similar in each study given their difference in derivation: Garbutt and her colleagues reviewed literature, then interviewed "key informants" e.g. consultants, pharmacists and survey design experts to derive their 102 item questionnaire. Han and Maxwell based their 42 questionnaire statements on the learning items pertaining to rational prescribing stipulated in the document "*Tomorrow's Doctors*". Ian Coombes and his team developed 21 closed statements following a literature review, focus groups and a pilot study carried out with 15 interns. All surveys contained questions in the following categories: perceived ability to prescribe safely; adequacy of training in rational prescribing and basic pharmacology; use of reference sources, staff influences on prescribing behaviours and recognition of factors that contribute to prescribing errors. Scoring of items was mostly graded on either a 5 or 6 point Likert scale. Response rates were 60.1% (175/291), 39.8% (100/251), and n=101 respectively.

Garbutt and her colleagues concluded that routine use of safe prescribing behaviours was poor amongst the group in their survey as a result of a poor knowledge base as well as sub-optimal attitudes. This theme was echoed by both Han and Coombes, however all 3 papers drew differing inferences from their studies. Han and Maxwell are consistent in their suggestion that there is insufficient teaching time in the undergraduate curriculum dedicated to learning about the correct and safe use of drugs and inadequate assessment of these skills. McCoubrie (2004) makes the point that student learning is often motivated by assessment. If students feel that a subject is inadequately examined, many are not driven to pursue the subject for purely altruistic reasons (because they need to know it for eventual practice). Garbutt *et al* reach a more psychological conclusion when they claim that rational prescribing skills are not prioritized by medical students since other health professionals (such as nurses or pharmacists) are also capable of making these therapeutic decisions. Coombes, Mitchell and Stowasser focus on "the culture of blame" in a hospital hierarchy and the effects of such a perception on disclosure and management of error.

In an attempt to obtain a more robust dataset, Heaton, Webb and Maxwell (2008) launched a web-based survey that was distributed to UK medical students and interns in graduation years 2006-2008. As with Han and Maxwell, they based their 17-item questionnaire on the learning items pertaining to rational prescribing stipulated in the document “*Tomorrow’s Doctors*”. A Total of 2413 responses met the eligibility criteria for analysis. Response rates for each graduation year were: 2006 – 18.8%, 2007 – 41.1% and 2008 – 40.1%. Respondents confirmed the findings of smaller studies (quoted above) where teaching and assessments in pharmacology were considered insufficient for attaining rational prescribing competence on graduation.

3.5 Prescribing competence of South African graduates

There are currently three studies where elements of prescribing competence have been assessed in South African final year medical students or interns. The consensus is that whilst confidence and competence to prescribe is deficient on graduation from medical school, these improve during the course of the internship year.

In a study on procedural skills competence in two Cape Town academic hospitals, three weeks after graduation, 58 graduates from South African medical schools participated in an objective structured clinical examination (OSCE) with 7 different stations (Burch *et al*, 2005). Skills tested included competence in phlebotomy, intramuscular injection, female pelvic examination, bladder catheterization, tracheal intubation, cardiopulmonary resuscitation and prescription writing. In this study, prescription writing scored the lowest of the seven tested skills. The authors comment:

“The limited ability of interns to write a correct prescription for commonly used medication, despite the availability of a reference text, was an unexpected finding”.

The finding was unexpected since the authors judged the prescribing task to be the least technically demanding skill in the test – and yet this task produced the poorest student performance. The authors advocate “a nationally standardized undergraduate skills training programme” in order to ensure that South African undergraduate medical training confers proficiency in the workplace. There are currently no guidelines delineating the competencies expected of South African medical students when they graduate. Although the HPCSA has stipulated educational objectives for undergraduate medical training, no formal list of “exit capability” has been produced (Burch *et al*, 2005).

In a qualitative study examining factors affecting the development of practical skills of interns, Jaschinski and De Villiers (2008) report that in the Western Cape

“Prescribing was noted by all groups as being a skill that was not well developed at university and was only practiced for the first time as an intern”.

This research was carried out in 5 different hospitals in the Western Cape with 25 participants who were 11 months into their intern experience. Five separate focus groups were convened to explore the question “Do you feel you were trained adequately in practical procedures to cope with the intern year?”

Lastly, at the University of Kwazulu- Natal, the first cohort to complete their new problem-based medical curriculum in 2004 acknowledged that prescribing confidence and competence was poor amongst the students. Harries and her colleagues (2006) determined that the focus of most PBL cases in their Medical School was on diagnosis and that students were underprepared to assume prescribing responsibilities. After administering a pre-test to determine which areas required the most intervention, they devised a week-long exposure to different prescribing skills and activities. Sixty-two percent of the class attended these sessions (they were held during the holidays) and the remainder of the students (who did not attend the sessions) comprised the control group for the post-test event. The intervention highlighted that an improvement in prescribing competence is possible through “classroom teaching”, without having to wait for experiential learning during the internship.

CHAPTER 4: RESEARCH DESIGN

4.1 Introduction

This study utilized both quantitative and qualitative research methods. Whilst quantitative methods can supply a “snapshot” analysis of the current competence of students, analysis of student perceptions within a qualitative framework was intended to lead to a holistic appreciation of students’ confidence to prescribe, and factors which could have affected access to this ability. According to Miles and Huberman (1994), “qualitative data are useful when one needs to supplement, validate, explain, illuminate or reinterpret *quantitative* data gathered from the same setting.” (Authors’ emphasis). **4.2 Methodology** This research concerned development of rational prescribing skills and intended to explore a range of students’ attitudes and abilities. An exploratory Case Study methodology was thus proposed, in which empirical evidence elicited was interpreted within a designated framework. The description of the research as a case study applied since the study focused on one class within one medical school, and produced data pertaining specifically to that situation.

Case study approaches do not stipulate specific research methodologies, however many established, traditional methods have been used to gather data. Anderson (1998) states that both qualitative and quantitative methods and measures have a place in case study research, however the emphasis should be on integration of data to interpret the natural setting. Asking questions, observing and examining documents are three major methods identified by Mouton (1996) as being suitable for data collection. In this study questions were asked and documents examined, however students were not observed in the act of prescribing, since this proficiency was not practically tested in the exit-level integrated examinations.

Cohen, Manion and Morrison (2000) discuss several different types of case study, with commonalities being the definition of a bounded system of enquiry and the consequent reservation concerning generalizability of results. Bassey (1999) explains that the intention of a case study is to obtain a rich, detailed understanding of a particular situation, which can inform analysis of that unique situation. Yin (1984), however, emphasizes the real-life context of case study research and comments that analysis of a well described case study need not be confined to one particular instance, but could also be used as a paradigm for discussion of similar situations or further research.

4.3 Operationalization

4.3.1 Analysis of Student Examination Performance

In order to determine student performance in rational prescribing, a specific “rational prescribing” examination mark was generated (from the existing computer marksheets) by including the examination questions which pertained to rational prescribing (as determined by the researcher and representatives of the undergraduate examinations committee) and excluding all non-prescribing related questions. These generated marks were statistically analysed as detailed (in section 4.3.4) below to determine difficulty of the items/test, variance between examinees, as well as to compare the “prescribing” mark against the total mark attained by the student in the examination. These marks were intended for research purposes, and were not divulged to the students or general staff. To maintain confidentiality of these data, students were allocated a study number and the key to the list was kept in a secured location. The focus of the research was to identify categories of students’ strengths and weaknesses in responding to the examination questions. There was no intention to compare individual results. Lastly, grouped data of student responses per item were compared with the taxonomic classifications assigned to each statement, in order to infer patterns for analysis with respect to students’ knowledge levels and preparation to cope with different cognitive challenges.

4.3.2 Surveying the Perceptions Of Students Questionnaire

In order to assess students’ perceptions of their competence to prescribe, as well as the knowledge, skills and behaviours important in developing rational prescribing skills, all members of the current GEMP IV class (in the faculty of Health Sciences, University of the Witwatersrand) were invited to participate in a directly administered cross-sectional survey using an internet-administered questionnaire (assuring anonymous responses) through the Centre for health science education (CHSE) electronic class noticeboard. A covering letter accompanied the invitation, stating the aims of the investigation.

The questionnaire was designed using SurveyMonkey and included directed responses, binomial and open-ended questions to elicit both nominal and ordinal data. The SurveyMonkey software was used for analysis of responses in order to investigate relationships within the data and group data into variables. The dependent variable (which is the unit of analysis) for this portion of the study was ‘student perception of prescribing competence’. Associations between this construct and independent variables elicited from the questionnaire (such as perceptions of learning opportunities, attitudes to error, experiences in the wards and choices of information sources) were then intuited and

conclusions drawn from the resultant patterns. Acceptability and applicability of the questionnaire was pre-tested on 6 students in the class. (See attached document on the questionnaire – Appendix C). The questionnaire was launched 2 weeks prior to the start of the students' final examination set and remained accessible until midnight on the day before graduation (approximately three and a half weeks).

4.3.3 Analysis of the Final Integrated Examinations

The GEMP IV integrated graduating examinations comprise 2 written examinations administered in a 3-hour morning session followed by a 3-hour afternoon session on the same day. The assessments include one paper containing 60 A-Type (single-best answer) multiple choice questions and one paper containing 60 R-Type extended matching questions.¹

Although the examinations were integrated, the questions relating to prescribing (as determined by the researcher and representatives of the undergraduate examinations committee) were extracted from the 2 examinations and subjected to analysis of the knowledge dimension being tested by the statements as well as the cognitive processes required to successfully answer the questions according to Bloom's revised taxonomy. The statements were assigned codes according to the categories within the taxonomy by the researcher, then separately by another staff member. The final categorization was agreed by discussion and consensus between the two opinions. The guidelines used to effect this categorization are in tables E2 and E3 in Appendix E (pages 120 and 121). In this way, degree of higher order learning objectives was determined and a judgment made as to the "quality" of the exam in testing rational prescribing skills. Using the same consensus methodology, exam statements were categorized within the SOLO taxonomy (see table E1, Appendix E for the definition of levels used in the categorization). The Division of Pharmacology examinations committee then subjected the 3 best answered and 3 worst answered questions per paper to structure and content analysis according to Case and Swanson's (2003) protocol for devising multiple choice examination questions. The unit of analysis for this segment of the research was the examination question.

4.3.4 Statistical Analysis

¹ Students have to have passed all clinical, practical and written examinations in each of the clinical blocks before being allowed to write the final integrated examination. The final integrated examination comprises 3 examination events, a written paper of 60 A-Type MCQs, a written paper of 60 R-Type MCQs and a computer delivered short-answer-question (SAQs) paper. For the purposes of this project, the SAQs paper was excluded as having too few "prescribing-type" questions to warrant extraction of the data.

Use of both qualitative and quantitative data was intended to add depth to the investigation of student prescribing. To this end, quantitative statistical analysis was only employed as an adjunct to elicit and interpret patterns within the qualitative data. Initially, categories within Bloom's taxonomy and the SOLO taxonomy were compared with student performance, however, since the initial perceptions questionnaire was anonymous, no comparisons between individual students' actual marks versus perceived competence could be made. For the perceptions questionnaire, the ordinal data produced from rating scales was analyzed with respect to frequency, and the subsequent trends were utilized to draw conclusions about associations.

With regard to the MCQs, both test and item statistics were generated routinely. Total test scores were documented as a frequency distributions as well as a histogram. In addition, the following were generated for the test overall as well as individually per item: The mean (which can indicate the test/item's overall difficulty), variance and standard deviation (indicating variability across examinees), reliability (a measure of inter-item consistency), and the standard error of measurement (a reference for estimating if and where examinee's performance are sufficiently different to consider them real differences). Item vs. test statistics include the difficulty level, which is the percentage of students who answered the item correctly, as well as the discrimination index, which provides information about the item's ability to differentiate between high and low-scoring examinees. (Case & Swanson, 2003). All of these statistics are generated through norm referenced methodology and rely on comparisons of student performance. Significance of these comparisons diminishes when students uniformly perform either very well or very poorly on a question, and, since this was the case for the majority of the questions on the prescribing exam, the quantitative statistical comparisons generated for the exam lacked power and were omitted from the subsequent discussion.

4.4 Validity, Reliability and Trustworthiness

Validity is a concept concerned with the extent to which an instrument actually measures what it is supposed to measure. Reliability reflects the amount of error inherent in any measurement (Mouton, 1996). As noted in the literature review, carefully constructed A-Type and R-Type MCQs are a feasible vehicle to deliver a valid and reliable test. The emphasis on

care in construction relates to validity of the test, since the test is intended to elicit interpretation, synthesis and application of knowledge, rather than English proficiency.

Whilst the concepts of validity and reliability are applied to quantitative research, Guba (1981) argues that the notion of “trustworthiness” is more representative of qualitative data. Guba (1981) defines trustworthiness to include truth value, applicability, consistency, and neutrality.

In this study, truth value was ascertained by two mechanisms: firstly, peer review of the selection, then taxonomic classifications of the examination questions and, secondly, triangulation of the ordinal (likert scale survey) data with the nominal (open-ended response generated) data.

Applicability of the data could depend on the representativeness of the sample – since the questionnaire was optional and, being administered close to exam time; students may not have participated in the study. The choice of administering the survey as a web-based instrument, launched via the class “electronic noticeboard” was deliberately to improve student participation: Since the survey was web-based, it could be answered at any time, from any internet-provided location (i.e. did not have to be completed while on campus). At that time of year, students had to check the noticeboard regularly for exam times and venues, as well as graduation information, so the survey was well publicised. Applicability of the questionnaire was pre-tested by 6 members of the GEMP IV class and reviewed by 2 members of staff, to identify ambiguities, unclear wording, and clarity of instructions, possible bias and relevance of questions.

According to Guba, consistency of the data can be ensured by logging an accurate “audit trail”, especially with respect to data collection and the links between analysis and interpretation. These links will be evolved as matrices of association, and will be discussed with colleagues for further verification. These discussions will also contribute to the notion of neutrality, since they will provide a basis for reflexive examination of the researcher’s interpretations within a wider framework of opinions and perspectives.

4.5 Ethical Considerations

The principles of ethical medical research involving human subjects as outlined in the Declaration of Helsinki (World Medical association, 2008) were followed in the design and execution of this study:

- All participants were over the age of 18 years
- Although the participants in this study were students and the researcher is a lecturer, the lecturer has no responsibility for the curriculum design, examination setting or administration of the GEMP course. This was actively communicated to the students
- For the perceptions questionnaire:
 - a) The notion of personal autonomy was respected by issuing an **invitation** to all students in the 2008 GEMP IV class to participate. There was a clear announcement that their participation was entirely voluntary and that it would neither advantage nor prejudice their academic progression. In addition, the participant could discontinue participation at any time without penalty or loss of benefits
 - b) A covering letter accompanied the invitation, stating the aims of the investigation, how long it should take to participate and inviting participation.
 - c) Responses were anonymous (since they were collected via a website)
 - d) Consent to participate was assumed by completion and return of the questionnaire.
 - e) The researcher's e-mail address was supplied as a contact link if any of the students wished to discuss issues related or unrelated to the project which may have arisen as a result of participating in the survey.
- For the assessment of rational prescribing competence in the examination papers:
 - a) **This mark was intended for research purposes, and was not divulged to the students or general staff.**
 - b) To maintain confidentiality of these data, students were allocated a study number and the key to the list was kept in a secure location. Only the principal investigator and supervisor had access to study numbers and links.
 - c) The focus of the research was to identify categories of students' strengths and weaknesses in prescribing competence. There was no intention to compare individual results.

Ethical approval to conduct this research was obtained from the Human Ethics Research Committee HERC (Medical) of the University of the Witwatersrand (See Appendix A for clearance certificate)

CHAPTER 5: RESEARCH FINDINGS AND INTERPRETATIONS

In this section I will consider the 5 sub-questions as the structural basis for explication of findings. Whilst the project generated quantities of data which exceed the bounds of this discussion, I will restrict my exploration in this project to the previously determined questions (however the full results-set appears in Appendix C).

The juxtaposition of these two sections is intended to increase the coherence of the discussion by analysis of the varied reported results in relation to applicable concepts. An account of student performance in the prescribing examination is followed by analysis of the MCQ item construction. The discussion of prescribing performance is concluded with a report on prescribing marks in relation to the full examination marks and the implications of poor prescribing performance for eventual professional practice. The next section in this chapter reveals the lack of correlation between student examination performance and students' perceptions of prescribing competence. This is followed by analysis of the prescribing examination questions according to the SOLO taxonomy, Bloom's revised taxonomy and also in relation to policy documents concerning prescribing outcomes. Section 5.4 documents students' perceptions of curricular delivery of rational prescribing skills in relation to quantity and sequencing of basic pharmacology. The subsequent section deals with the notion of situated learning and, in addition, student perceptions of examinations as a factor which they identify as influential in their learning of rational prescribing skills. Lastly, a Bernsteinian lens is used to view a synthesis of the findings in relation to issues of power and control in delivery of the rational prescribing curriculum within the GEMP and the ultimate effects on students' access to the practice.

5.1 Students' Prescribing Performance

As described in the methodology section 4.3.1 above, questions pertaining to prescribing from the 2 final multiple-choice papers were extracted from the integrated examination in order to deduce a "Prescribing Mark". Here, I report on this extracted mark and further examine it in relation to the two types of MCQs in Paper 1 and Paper 2. Lastly, to contextualise these findings, I contrast students' prescribing marks with their overall performance, both individually for R-Type and A-Type MCQs and cumulatively for the whole examination.

5.1.1 Prescribing Marks

One hundred and fifty two students sat for the final integrated examinations at the culmination of GEMP IV in November 2008. The discussion on student performance that follows utilises the full set of results obtained from the 2 multiple-choice examinations, with frequency of grades reported as a calculated percentage of the class. Grading categorizations were as follows²:

Grade	Symbol in Charts	Mark Range
Fail	F	<60%
Second Class Pass	2	60% - 69%
Upper Second Class Pass	U2	70% - 74%
First Class Pass	1	>75%

The chart displays marks for Paper 1 (R-Type MCQs) and Paper 2 (A-Type MCQs) which were averaged to obtain a “final” prescribing mark. The range of student performance in the “prescribing exam” is thus documented.

² It is beyond the scope of this report to discuss the methods utilised by the CHSE to determine the pass/fail standard of this examination set.

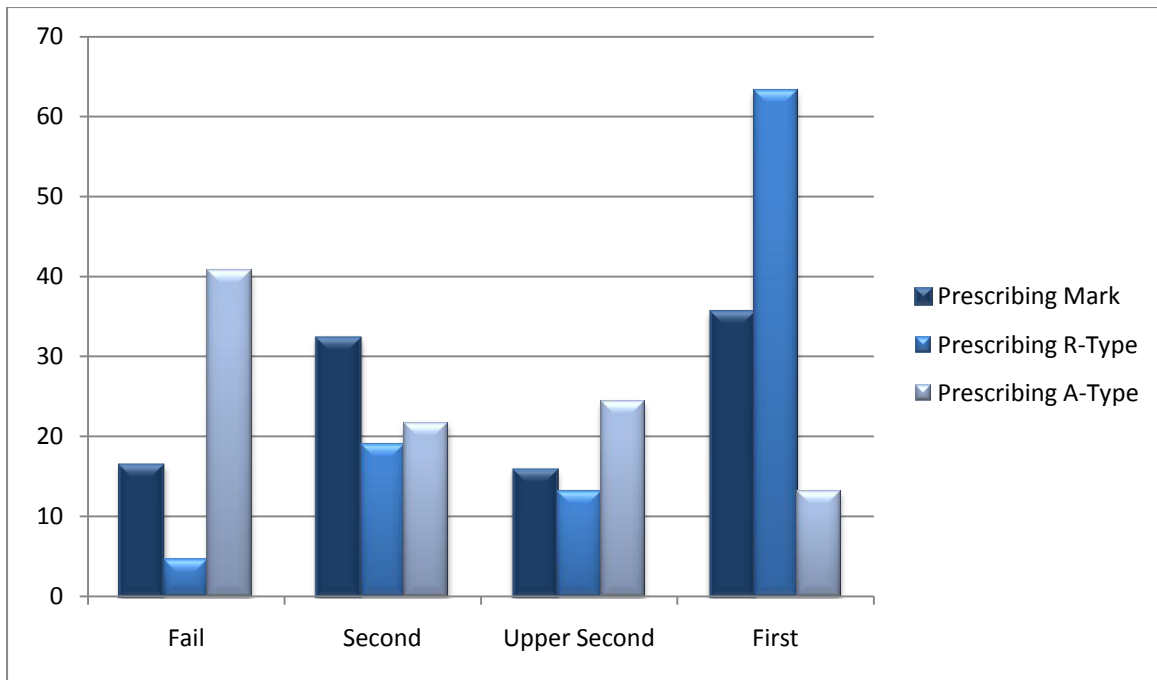


Figure 1: Prescribing Marks Overall and For Paper 1 (R-Type) and Paper 2 (A-Type)

The results show that 83.6% of students achieved a passing grade on the “Prescribing Assessment”, with 35.5% of students scoring first class passes and 16.4% failing to achieve the 60% pass rate. The class average for the exam was 68.9%. Examination of the contribution of the 2 individual papers to this result revealed that 63.2% of the class achieved first class passes for the R-Type questions whilst only 13.2% scored firsts for the A-Type MCQs, thus showing that the rate of “firsts” is predominantly attributable to the high scores on Paper 1. The converse is demonstrated for the failure rate, where 40.8% of students failed to attain 60% in Paper 2 and only 4.6% failed Paper 1, contributing to the cumulative failure rate of 16.4%. This is borne out by the respective class averages per paper, being 78.1% for the R-Type MCQs (a clear first class pass) and 61.5% for the A-Type MCQs (only just above the 60% pass grade). The statistical difference between the R-Type prescribing mark and the A-Type prescribing mark was significant ($P < 0.0001$, $t = 13.690$, 151 degrees of freedom).

Clearly, our students are more successful in identifying the correct answer in R-Type questions as compared with A-Type questions; which, in the light of current literature, is an anomalous finding³. With respect to the use of R-Type MCQs for medical examinations, Case and Swanson (2003) claim that these “extended-matching questions” are more difficult

³ The success of students in Paper 1 over the results for Paper 2 maintains its statistical significance even when adjusted for the difference in the number of relevant questions per test included in the “Prescribing mark”.

than other question types, including single-best answer (A-Type) MCQs since they negate the effects of cueing. In a similar vein, McCoubrie and Knight (2008) document the preference for R-Type MCQs (over other types) in high-stakes qualifying examinations since this question construction encourages the “application of knowledge, not recall of an isolated fact”. Beullens and his colleagues (2002) indicate that R-Type questions discriminate best between students who know the material and students who don’t. Such excellent results in the most discriminating MCQ format seem to indicate that the entire class is fit to prescribe rationally on their first day of practice.

5.1.2 Analysis of MCQ Item Construction

The reasons for better performance in the R-Type questions compared with the A-Type questions, however, remain obscure. Downing (2005) comments that items which contravene construction principles tend to reduce pass rates. MCQ items included in all GEMP exams are constructed according to a validated set of rules (Case & Swanson, 2003) which are strictly enforced. Before incorporation into an examination, questions are scrutinized by a committee comprising the academic staff of the Division of Pharmacology. Factors which are checked include that the item content falls within the “blueprint” for the learning objectives for the group and that the standard item writing principles have been adhered to. Common flaws in test statement writing include that the stem is unclear, the options contain imprecisely defined terms or the options are partially correct (Case & Swanson, 2003). Once questions have been forwarded to the CHSE, they are again examined for appropriateness of content and structural accuracy by the GEMP examinations committee. With such scrutiny by trained personnel, it seems unlikely that the lower pass rate in Paper 2 could be attributed to incorporation of flawed MCQ items in the exam.

In order to explore this assumption, the 3 “worst answered” (lowest scoring) and 3 “best answered” (highest scoring) questions in Paper 2 were analysed for construction flaws according to the full list of requirements stipulated by Case and Swanson (*ibid*). For comparison, the 3 lowest scoring and 3 highest scoring questions in Paper 1 were subjected to the same scrutiny. Questions chosen for item analysis were numbers 41, 38, 33/ 48, 22, and 40 in Paper 2 and numbers 30, 18, 22/ 34,21, and 35 in Paper 1.

Only 14.5% of the class answered question 41 correctly, and the reason for this was immediately apparent: Case and Swanson (2003) recommend that with A-Type questions, the clinical vignette and question stem should be so clearly constructed that it should be possible

to answer the question without looking at the 5 options given. For question 41, the most appropriate antiemetic agent for the given vignette was not in the options list – so, although they could still choose between the 5 antiemetics listed, students’ “ideal” answer was not the same as their written answer. This procedural flaw caused confusion, with most students being unable to distinguish mechanistically between the given listed options.

For question 38, 34.2% of the class chose the correct option (b), whilst 36.2% and 24.3% chose the 2 “next best” options (a and c respectively). It was apparent that the majority of the class was able to distinguish that options d and e were distractors, however most had difficulty in differentiating between the first 3 options, since these drugs all act by similar mechanisms. Since the question was technically accurate with respect to construction rules, the content was scrutinised in an attempt to explain the students’ difficulty with this question. Analysis of the content reveals that insufficient clinical experience with hypotension in anaesthesia could account for students’ inability to make the correct choice. Those who succeeded in answering this question either recalled the use of ephedrine as a pressor agent in spinal anaesthesia or managed to apply their knowledge of pharmacokinetics and pharmacodynamics of the listed options in order to deduce which was the most correct answer. Poor performance in this question could thus be attributed to an inability to *recall* which drug would be best, or an inability to *apply* clinical pharmacological knowledge to work out which drug would be best.

Since questions 39 and 16, the next poorly answered questions in the exam show similar reasoning for lack of success, I would prefer to discuss question 33, which highlights an interesting finding: The question reads as follows:

A 10-year-old girl with atopic dermatitis reports itching that has become relentless, resulting in sleep loss. Her mother has been reluctant to treat the girl with topical corticosteroids, because she was told that they damage the skin, but she is exhausted and wants relief for her child.

How should the problem best be managed to induce remission?

	Class response (% correct)
a. Topical emollients	9.2
b. Oral antihistamines	38.8

- c. Topical corticosteroids 50.7
- d. Elimination of dairy products from the diet
- e. Evening primrose oil supplementation

Although 50.7% of students correctly identified option c – topical corticosteroids as the best agent to induce remission of atopic dermatitis in this patient, 38.8% of the class chose option b – oral antihistamines. Whilst oral antihistamines are useful in the management of atopic dermatitis in children, their usage is limited to children under the age of 8 years. In this vignette, the child was 10 years old and thus it seemed obvious that option b was not the best choice. Thus, students who chose option b may or may not have known about the age-related decline in use of oral antihistamines, but I believe it is more likely that they misinterpreted the stem of the question: My reasoning for this arises from the wording of the question: Bearing in mind that for many of the students English is a second or third language, the use of the connector “*but*” in the question may have misled their choice giving rise to the misinterpretation that the mother *continued* to be opposed to the use of topical corticosteroids for her child. Therefore, although not optimal, item b was the best option offered to them on the list since item c was made unavailable by their interpretation of the stem. Conversely, the use of the word “*but*” privileged those students proficient in English, since it indicated that the mother previously didn’t want to use topical corticosteroids on her child, *but* she has now changed her mind (since she is exhausted) and thus topical corticosteroids *can* be used. The discrimination index of 0.36 on this question indicated that the question discriminated well between students who scored well on the exam and those that did not – however, the question could just be discriminating between those who correctly interpreted the use of the word “*but*” and those who did not.

Turning to those A-Type questions that were best answered (48, 22, 40), interestingly questions 48 and 22 shared an item set of analgesic options for a patient, with different clinical details in the vignette. In question 48, 96.7% of students identified the correct answer, whilst 90.8% of students identified the correct option in question 22. Clearly, students feel confident in choosing answers concerning analgesia, however the greater number scoring the correct answer may not have been related to the clarity of the vignette, but rather to the fact that in question 48, options were listed by mechanistic class with an accompanying example, whereas in question 22, the options were listed as drugs only – with no mechanistic class, making the choice of correct option slightly more difficult. Since all of these questions were

uniformly construction according to the guidelines, little additional interpretation concerning question design was possible.

In Paper 1, questions 30, 18, 22/ 34, 21, and 35 all required students to select the best treatment option for a particular patient from a list of alternatives. No construction flaws were apparent in the items giving rise to the interpretation for questions 30, 18 and 22 that the students lacked the content knowledge or application skills to be able to distinguish the correct answers from the distractors. Similarly for questions 34, 21, and 35, students were very successful in identifying the corresponding drug treatment from the vignettes.

In summary, content analysis of questions in Paper 1 and Paper 2 revealed that MCQ items were generally constructed according to the recommended rules and did not constrain students' accurate responses. However, poorly answered items in Paper 2 highlighted some construction flaws and may indicate that despite the peer review process, it was more difficult to construct error-free A-Type questions. This finding may contribute towards an explanation of why students scored better in Paper 1 than in Paper 2, but the situation is further explicated in Section 5.3.

5.1.3 Comparison of Prescribing Examination Marks with the Overall (FullExam) Marks.

A 2009 Schedule to the South African Health Professions Act, (Act No. 56 of 1974) published regulations relating to undergraduate curricula and professional examinations in medicine (GN139GG31886 of 19January2009). A number of desirable outcomes relating to the knowledge, skills and attitudes of medical graduates were enumerated, including:

“In order for a graduate to have a sound knowledge and understanding of health care and the promotion thereof and of the prevention and management of disease, such graduate shall have...

(e) knowledge of the principles of therapy and disease management.”

Further, the graduate should be able to “formulate a plan for treatment and management based on sound professional reasoning and problem-solving abilities” (ibid).

The schedule does not specify a direct assessment method for these outcomes, thus allowing the University latitude in developing its own assessment criteria⁴. However, after examining both integrated and discipline specific assessments, Maxwell and Walley (2003) vociferously support a separate pre-graduation assessment of prescribing competence. They maintain that it is important to identify students who have poor knowledge about drugs and who are inadequately prepared to prescribe before graduation since, on account of their inadequate knowledge base, such individuals struggle to develop rational prescribing competence during their internship.

Since this study required devising a “Prescribing Mark” for the graduating class, it was opportune to utilize this assessment to evaluate if there were any students in the class who passed the overall examinations (FullExam Mark >60%) but who did not achieve a passing grade in the prescribing examination (as Maxwell and Walley suggest could happen). In other words, this part of the analysis was undertaken to answer the question “were there students who compensated for a poor performance in prescribing by doing well in other sections of the integrated exam?”

The following chart compares FullExam marks to prescribing marks and highlights instances where students failed to achieve a 60% rate (pass mark) for the prescribing assessment, but did achieve a passing grade for the complete integrated examination (purple sections):

⁴ These assessment criteria, together with the curriculum for delivery of the stated knowledge, skills and attitudes are audited for quality by the Health Professions’ Council of South Africa, (HPCSA), the regulatory body tasked with maintaining standards of medical education for safe and effective practice.

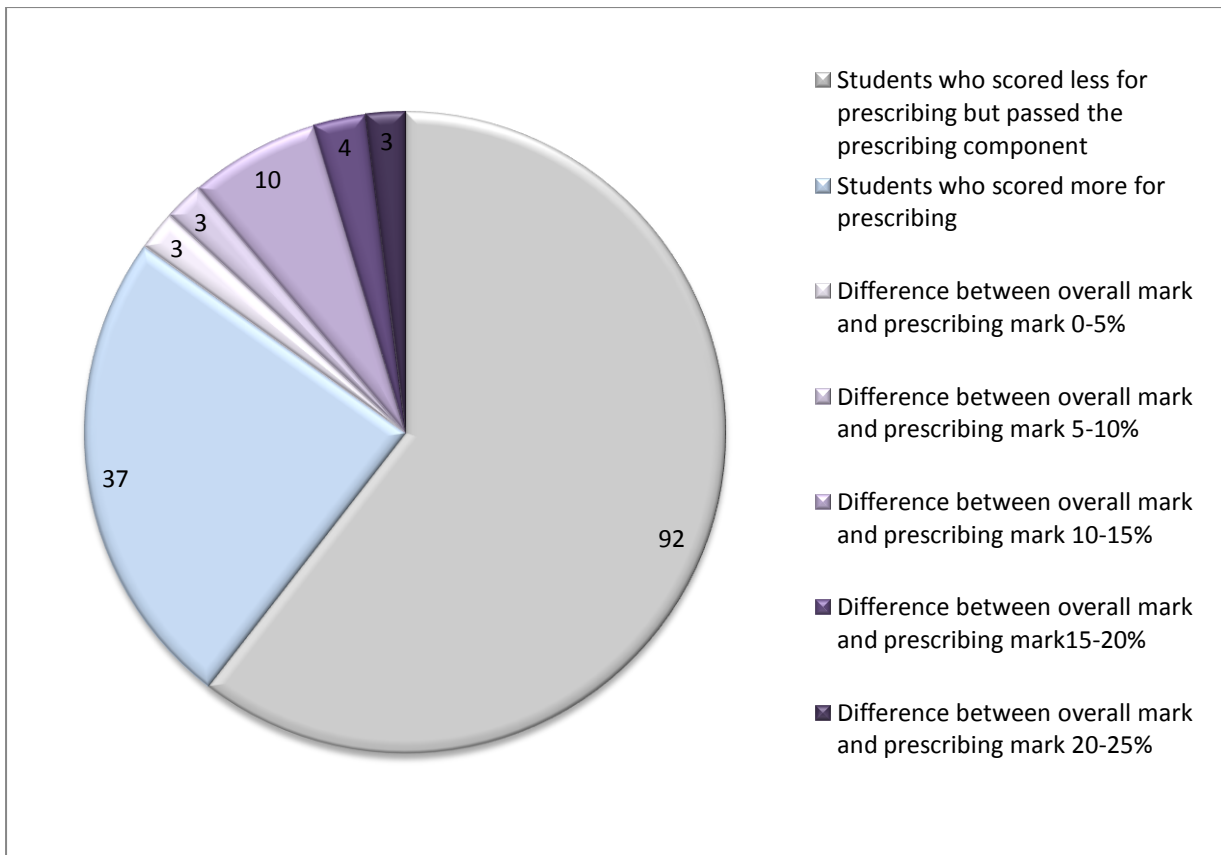


Figure 2: Comparative Student Scores on the FullExam and Prescribing Component

Seventy five point seven percent (115/152) of students scored **less** for the prescribing assessment than their FullExam scores (reflected by the grey and purple areas on the chart). Of this percentage, the majority (92/115, 80%) of students achieved the passing grade for both the FullExam and the prescribing assessment (grey area only), so, although they scored less for the prescribing assessment, they passed both exams.

The intention here is to compare outliers who performed significantly differently on the two examinations. Thus, students who attained a prescribing mark within 5 points of (either more or less than) their FullExam score were not considered in this analysis. Thirteen point two percent of the class (20/152) scored between 5 and 25 marks **less** than their FullExam mark **and failed the Prescribing Exam**, but still achieved a pass mark in the FullExam (purple segments of chart). In contrast, 10.5% (16/152) of students scored between 5 and 15 marks **more** on the prescribing assessment than they did on the FullExam (blue section of chart).

When comparing the range of marks scored separately in Paper 1 and Paper 2 (see the graph below), it is evident that students scored best on the R-Type prescribing questions, with the highest minimum score (56.5%) and the highest maximum score (100.0%). Although some

students scored well on the A-Type prescribing questions (maximum score of 90.9%), the majority did not, with a minimum mark of 27.3% (5 students scored this lowest mark) and median mark of 63.6%.

For the FullExam, both Paper 1 and Paper 2 produced results in a similar range (minima 51.7% and 50.0% compared with maxima: 95.0% and 90.0% respectively), showing the same trends as the R-Type prescribing questions. Although generally congruent with the results of the class, where top-scoring students do well in prescribing choices and under-prepared students manage poorly on those questions, there is a small but significant group evident that achieves well in the examination overall, but scores poorly in their rational prescribing questions. These results are discussed in the context of factors which either permit or constrain access to prescribing competence in section 5.3 below.

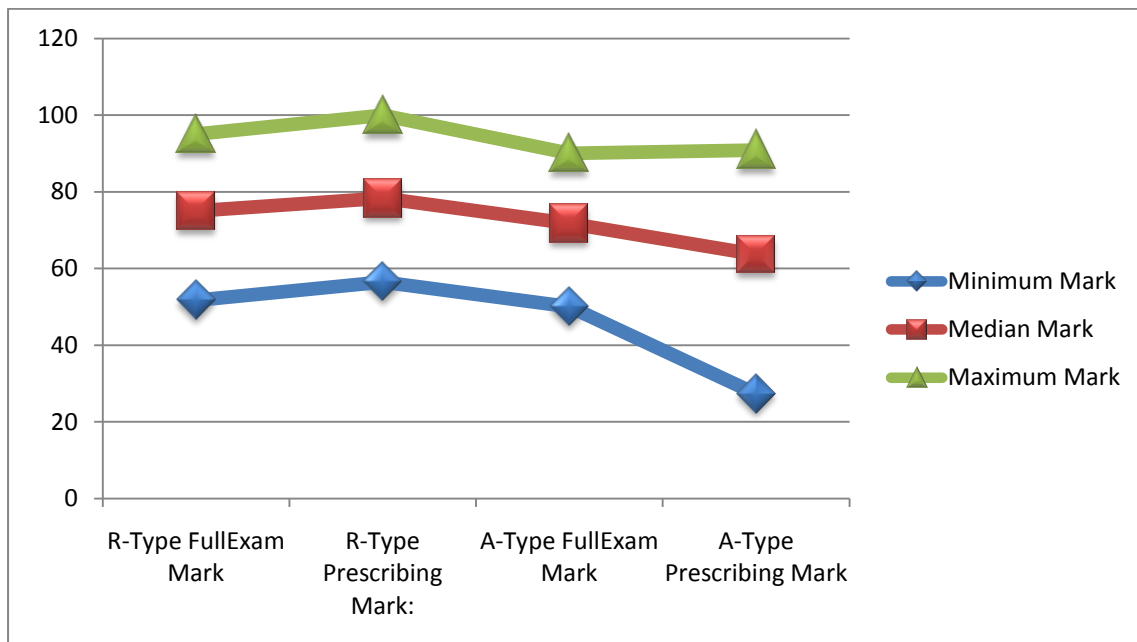


Figure 3: Graph of Range of Marks and Medians for R-Type and A-Type MCQs for the FullExam and Prescribing Exam.

5.2 Correlation of Examination Performance With Students' Perceptions of Competence

In the preceding section I have noted that 83.6% of students passed the prescribing exam, achieving quantifiable competence in rational prescribing. In this section, data from the perceptions questionnaire is presented. Responses to questions 7 and 10 are analysed, with supporting student comments from the free-text responses.

In response to the statement "I feel confident that my training will enable me to prescribe rationally when I am qualified" 13.1% of the students responded positively, 66.3% of the students responded negatively and 20.6% remained neutral.⁵ For comparison, in the largest survey on prescribing confidence to date, 29% responded positively and 42% of respondents responded negatively (Heaton et. al, 2008). Although there are many differences between the situation in the UK and local conditions, the figures in this study confirm the trend that students do not feel confident to prescribe rationally when they graduate.

Molokwu *et al* (2008) state that confidence to prescribe rationally only comes with practice, responsibility and adequate supervision. This statement is borne out by the more comprehensive responses obtained in question 7. As detailed in the chart, prescribing activities where students were (a) responsible for drug choices, (b) given the opportunity to fill in the patient chart themselves and (c) mentored with respect to drugs and dosages, such as during the integrated primary care (IPC) block and the 3-week medicine management block, allowed confidence in skills to emerge. Students reported confidence in common activities such as initiating therapy for hypertension, tuberculosis or HIV and counselling patients on malaria prophylaxis and contraception. The majority were also confident in their skills to take a drug history, calculate the dose of drug to administer and complete a discharge prescription. Lack of confidence was apparent in more complicated patient management, especially those situations where prescribing decisions involved making individual choices for particular patients, not prescribing a set drug regimen.

⁵ Questions requiring quantification of opinion in the perceptions questionnaire were recorded on a Likert scale, with those responding "agree" or "strongly agree" being classed as a positive response (%P) and those answering "disagree" or "strongly disagree" being classed as a negative response (%N). Most questions also allowed a neutral option.

TABLE 6: RESPONSES TO QUESTION 7 REGARDING PRESCRIBING CONFIDENCE		
7. How confident do you feel to accomplish the following tasks unaided?	%P	%N
Writing a legal prescription	59.7	40.3
Using abbreviations to give instructions on medicine usage	62.5	37.5
Choosing therapy for a patient on the basis of evidence in the literature (EBM)	59.7	40.3
Prescribing in special cases (pregnancy, renal failure, hepatic failure, extremes of age)	11.1	88.9
Avoiding Adverse Drug Reactions and Drug Interactions	11.1	88.9
Taking a drug-history	90.3	9.7
Calculating the dose of drug to administer	80.5	19.4
Completing discharge prescriptions	68.1	31.9
Ordering IV fluids	50.0	50.0
Knowledge and management of different formulations used in diabetic patients	27.8	72.2
Initiating warfarin therapy	25.0	75.0
Initiating therapy for TB	88.9	11.1
Initiating therapy for hypertension	88.9	11.1
Initiating antiretroviral therapy	80.6	19.5
Giving advice on malaria prophylaxis	70.9	29.2
Giving advice on contraception	88.9	11.1

Thus, students reported lack of confidence in managing a diabetic patient or titrating warfarin therapy in a patient requiring anticoagulation. Of concern is the finding that students lack

confidence in making prescribing choices for special cases for example pregnant patients, geriatric and paediatric patients or those with renal or hepatic failure. They also feel unqualified to apply the principles involved in avoiding adverse drug reactions and drug interactions. I will return to these concerns shortly, but at this juncture will insert some of the general free-text comments, which highlight this lack of confidence⁶:

- “We need to have a better knowledge our skills are very focused on diagnosing as opposed to treating”
- “I am confident that I will be able to diagnose the patient correctly but I will fail in treating them adequately”

Most of the students agreed that the curricular focus was on diagnosis, however several offered opinions as to why they felt that their prescribing skills were inadequate:

- “mostly no one corrects your mistakes, and you think what you doing is right. I still feel scared for the coming year”
- “pharmacology lectures in GEMP I and II made no sense and does not apply to what u have to know in the ward. So now I don’t know enough”

Here the students raise issues of supervision and feedback, dealing with errors and application of theoretical knowledge to practical problems, however the common thread is their fear and underpreparedness to prescribe.

It seems that there is a dichotomy: Why do students display a pervasive lack of confidence in their prescribing skills when their actual measured competence indicates that they are qualified? Not only that, but when viewed quantitatively, the responses in Table 6 seem to reinforce the results of the prescribing exam since, on individual questioning per task in question 7, students expressed confidence in eleven out of fifteen situations.

In this instance, the quantitative data were insufficiently sensitive to explain the differences and I turn to qualitative analysis to clarify some of the issues. The eleven competences in

⁶ The wording including spelling, punctuation and grammar of all student responses has been quoted verbatim. Since these were not transcribed, but inserted in the text through “cut and paste” technology, errors may be taken to be the students’. However, for ease of reading (and since English proficiency was not the major thrust of this research) I have omitted to label each anomaly.

which students claimed proficiency were all examples of common tasks which a graduating student would have encountered during their training. In the ward situation, however, it is possible to learn “the format” of how to deal with these cases, without resorting to basic principles of drug management. A student explains (in reference to drug management):

- “when it is the same I can cope but there are sometimes changes in even ordinary patients that no one can explain why it is like that. you just have to learn it “

This student seems to indicate that she⁷ has learned the management of certain conditions by rote and cannot apply basic principles in justifying her drug choices. This gives credence to the argument that students’ knowledge and skills concerning basic principles of individual patient management are weak. Returning to Table 6, it is not the skills in which students are confident that are significant, rather it is those competences which they clearly identify they do *not* know (application of knowledge to individual cases) which provide insight into the argument.

I will continue with this theme in the next section, where a qualitative analysis of the prescribing examination yields further interpretation of the particular challenges faced by these students.

⁷ Student responses to the perceptions questionnaire were anonymous – thus the gender of students in quoted comments is unknown. For ease of reference, I will use the female pronoun when necessary in the discussion, just to make the point that the widened access to the GEMP has increased the number of female students in the course.

5.3 Analysis of assessment of rational prescribing competence in the final integrated examinations

Having exposed the lack of congruence between the successful student examination performance in rational prescribing and student perceptions of underpreparedness to prescribe, I turn to an evaluation of the “Prescribing Examination” in order to explicate these anomalous findings.

Every “prescribing” related question in Paper 1 (R-Type MCQs) and Paper 2 (A-Type MCQs) was subjected to analysis as discussed in the section 4.3.3 above. Each question was evaluated for the level of cognitive challenge which it represented according to the Structure of the Observed Learning Outcome (SOLO) taxonomy (Biggs & Collis, 1982). The question was then assigned to a category of knowledge dimension according to Bloom’s revised taxonomy and then classified according to the level of cognitive challenge presented by the question (Anderson, 2005). The full data table may be accessed in Appendix D, however the following charts display the results of this process:

5.3.1 Classification according to the SOLO Taxonomy:

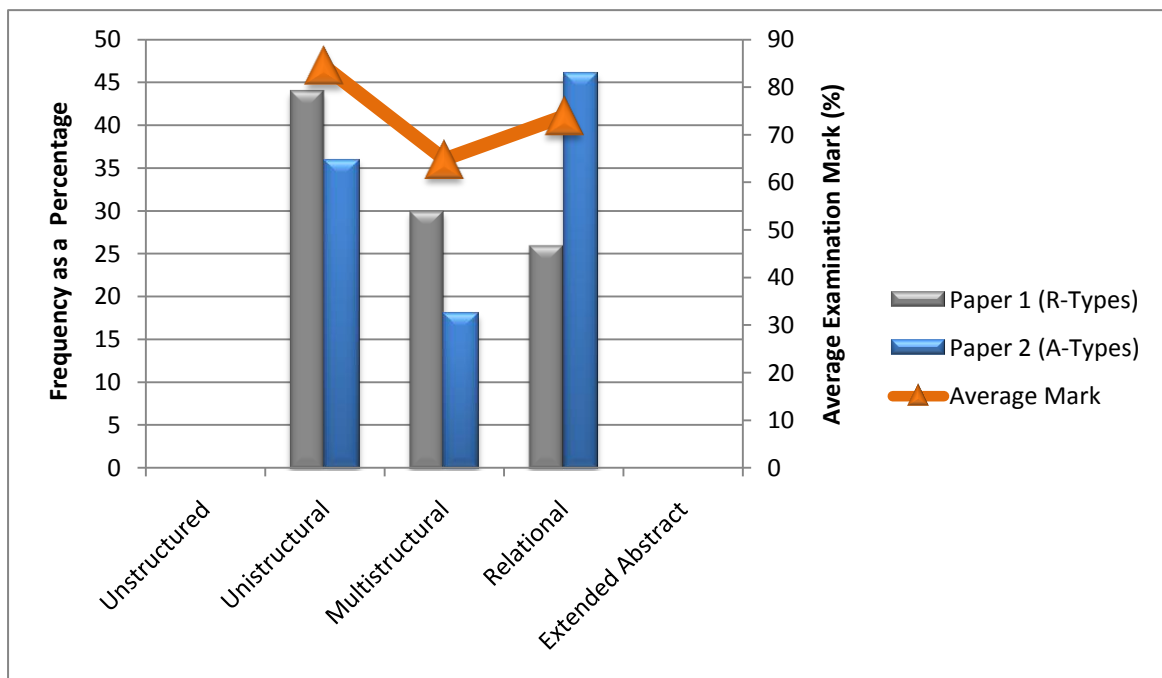


Figure 4: Classification of R-Type and A-Type MCQs according to the SOLO Taxonomy

The Structure of the Observed Learning Outcome is essentially “a framework for understanding understanding” (Biggs, 2003). The taxonomy can be used to categorise the quantity of detail in a student’s response and also incorporates a qualitative judgement of how the details are integrated into a structural pattern. In the Prescribing Exam, the questions were classified according to the stage of structural complexity required to produce the correct response. Overall, 41.2% of the MCQs required a unistructural response, 26.5% of questions required a multistructural response and 32.4% a relational response. The overall prominence of questions requiring simplicity of response is unexpected when one considers that rational prescribing is a skill requiring evaluative ability. In addition, the hierarchical nature of the SOLO taxonomy indicates that competence in lower levels of structural complexity are assumed if students produce higher order, integrated responses thus a test requiring evaluative performances could also provide evidence of unistructural and multistructural capabilities.

When comparing between Paper1 and Paper 2, however, it is evident that Paper 2 (A-Type questions) contained many more relational type questions than Paper1 (R-Type questions), where unistructural questions predominated. Poorer student performance on the relational-type questions is a cause for concern, since these questions are a closer reflection of the skills needed in practice. The poorest performance, however, was noted for multistructural questions. This may relate to the content of these questions rather than their structural complexity since the majority of these questions concerned areas where students had noted their lack of confidence; prescribing for an elderly patient, drug interactions, use of warfarin.

The strong performance in Paper 1 (R-type, predominantly unistructural question) could indicate that students adopted a surface approach to learning which realized them sufficient success to prevent them expending extra effort to develop deeper learning approaches. Their insecurity concerning prescribing skills may stem from the recognition that whilst such a learning strategy may prove successful for exams, it will not afford them access to the logic and eventual competent practice of rational prescribing.

5.3.2 Classification According to Bloom’s (Revised) Taxonomy

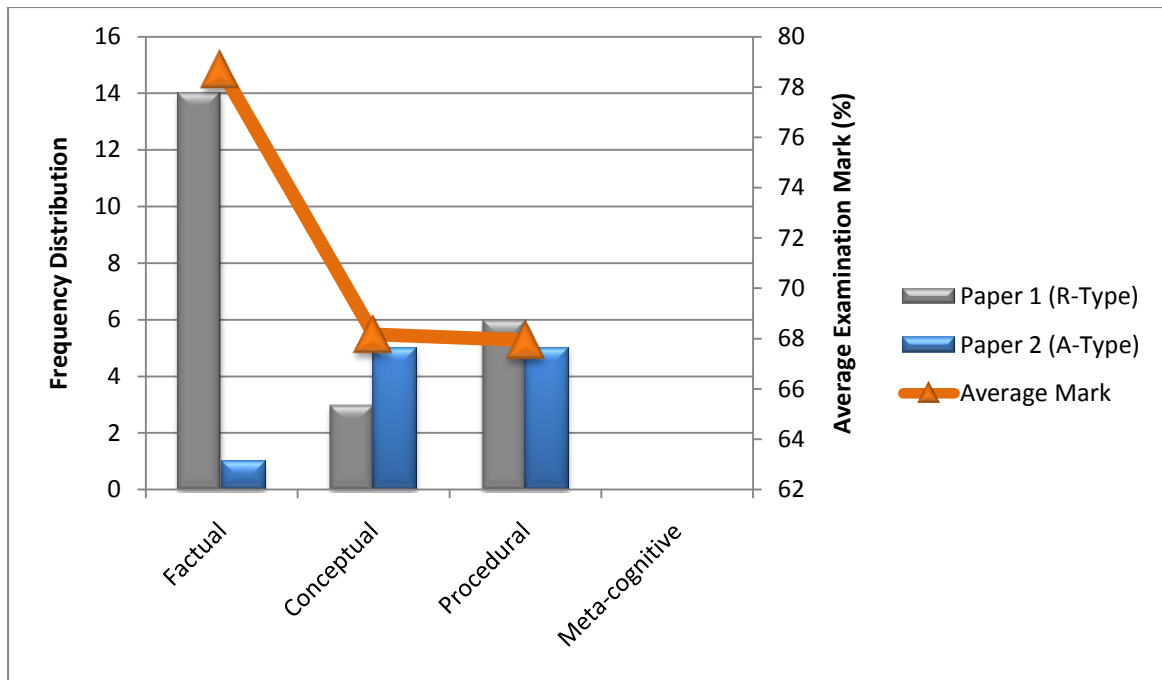


Figure 5: Bloom's Knowledge Dimension: R-Types Vs. A-Types

When assessing the knowledge dimensions of the MCQs according to Bloom's Revised taxonomy, we see that the R-type questions in Paper 1 tested mainly factual knowledge, whereas the A-Type questions (Paper2) tested a mixture of procedural (knowing how) and conceptual (knowing why) knowledge. Interestingly, the majority of students recognised what knowledge was valued in the context of the examinations and student performance indicated realisation of this content. Such a finding can be explained when one considers the strongly positivist epistemological approach of the staff in the Division of Pharmacology, and their concomitant commitment to the importance of testing factual knowledge. It does, however highlight a need for better communication between the Division and the CHSE regarding constructivist approaches to curriculum, pedagogy and assessment.

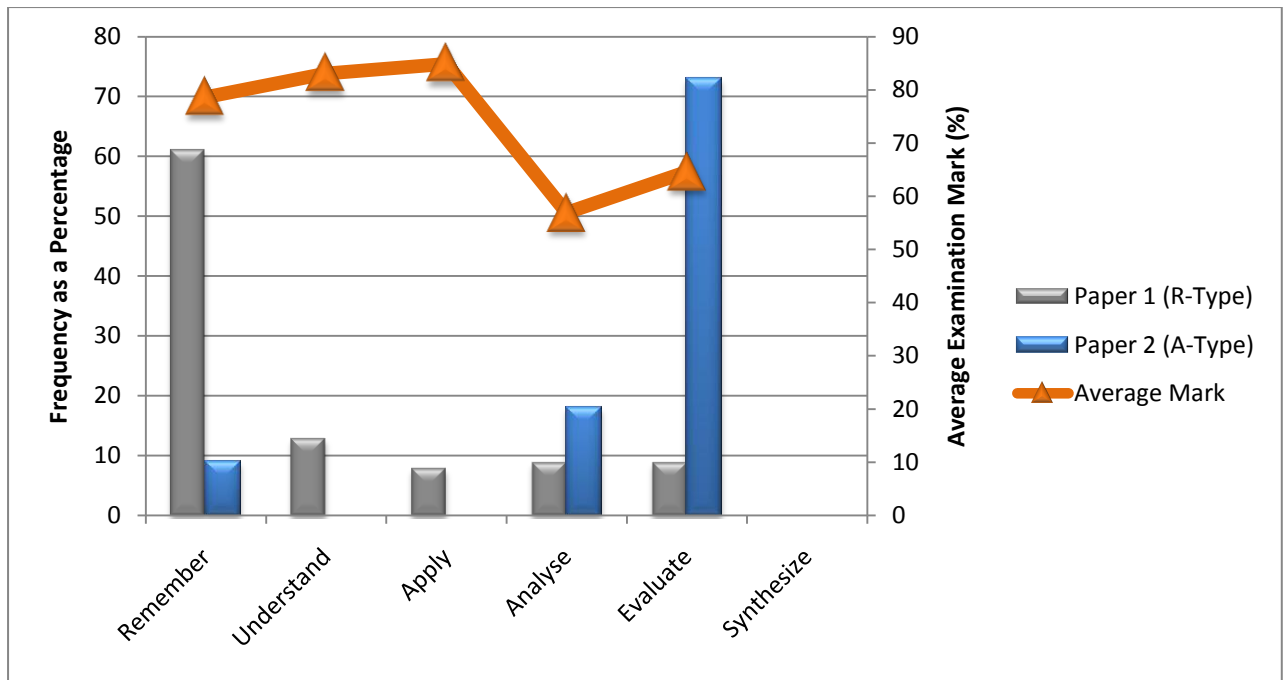


Figure 6: Bloom’s Cognitive Dimension: R-Types Vs. A-Types

Congruent with the results of classification of the knowledge dimension of the questions, according to classification by Bloom’s cognitive dimension, the majority (61%) of the questions in Paper 1 (R-Type questions) required students to remember. Of the 23 relevant questions in this paper, 9 questions required an almost equal spread of understanding, application, analysis and evaluation.

In Paper 2, the majority of A-Type questions required evaluative skills, with 1 question depending on memory and 2 questions requiring analytical skills. This is the preferred profile for testing of clinical skills:

“ we nevertheless maintain that testing knowledge through contextual vignette, or problem-solving questions that require reasoning skills is preferable to testing the recall of isolated facts.” (Jozefowicz et.al., 2002).

Thus, the A-Type questions were a more valid test of prescribing skills when considering the dimension of cognitive challenge and also produced a profile of attainment that more closely resembled students’ confidence to prescribe.

5.3.3 Classification According to Prescribing Outcomes

Turning now to Harries' *et al*(2006) delineation of skills (involved in prescribing) to be tested, questions in Paper 1 and Paper 2 were categorised according to the skill being tested by the question.

TABLE 7: CATEGORISATION OF EXAMINATION QUESTIONS ACCORDING TO PRESCRIBING OUTCOMES		
Skill	Skill description	Categorization of Questions R=Paper 1 (R-Type MCQ) A= Paper 2 (A-Type MCQ)
1	Selecting appropriate treatment	R9; R10; R18; R19; R20; R21; R22; R23; R30; R31; R32; R33; R34; R35; R36; R37; R38; A16; A17; A22; A23; A25; A33; A38; A39; A41; A48
2	Using guidelines to guide prescribing	
3	Medical literacy: understanding package inserts and the South African Medicines Formulary	R26; R27; R28; R29
4	Counseling	A39
5	Critical assessment of company literature	
6	Detection, monitoring and treating drug-related adverse reactions	R24; R25
7	Interpretation of drug levels/ monitoring and using these to guide prescribing	
8	Dosage calculation	R26; R28; R29
9	Avoiding/ combating polypharmacy	

It is evident that the majority of questions concerned selection of appropriate treatment as the skill to be tested. This finding is congruent with the previous categorizations, since the skill

of selecting appropriate treatment can apply to remembering unistructural, factual knowledge, but can also apply to evaluative choice of treatment in response to a clinical vignette.

However, in focusing on just one skill in rational prescribing, the examination simplifies the complex decision-making involved in safe and effective individual prescribing. The questions become “well structured puzzles” (Strohm-Kitchener, 1983) where the elements required to solve the puzzle are known. “Ill-structured” or “real-life” problems, on the other hand, require active choices in the integration of theoretical assumptions towards formulation of “best-fit” solutions. This concept lies at the heart of success in rational prescribing. Practitioners are required to make drug choices on the basis of incomplete data sets; they must understand the nature of the problem and choose acceptable strategies for coping; however this skill set is concomitantly harder to test (Richir *et al*, 2008). It is thus evident that basing the majority of questions on a single skill to be tested does not assess the gamut of prescribing skills. It seems that although the majority of students succeeded in the final integrated examination, they are aware that there is more to rational prescribing than was tested here⁸. This may have contributed to students’ impressions that the overall skills of prescribing are not sufficiently tested in their course. (As seen in section 5.5.1 below).

5.3.4 Validity and Reliability of the Exam

Validity, as defined by Babbie in de Vos *et al* (2005) “refers to the extent to which an empirical measure accurately reflects the concept it is intended to measure.” while reliability refers to the consistency of a measurement (Linn and Miller, 2005:68) One of the justifications for using MCQs in “high-stakes” qualifying exams is that they can increase validity of the test since they allow a large amount of work to be examined in a relatively short space of time (compared with, for example, essay questions or practical examinations). In addition, reliability of this testing method is ensured since questions can be impartially computer-marked (McCoubrie & McKnight, 2008).

In assessing degree of validity of the final integrated exams as a test of rational prescribing competence we should take cognizance of the fact that students are assessed using a varied set of instruments at regular intervals throughout GEMP III and IV and thus this region could be adequately tested elsewhere in the curriculum. However, the integrated exam is a “high-

⁸ Whilst clinical pharmacology decisions are tested in other examination events throughout GEMP III and IV (e.g. OSCEs and clinical presentations) students report little formal testing of rational prescribing

stakes” test since it is used as a measure of fitness to graduate – and thus its validity in adjudicating prescribing skill is important⁹. With respect to reliability (of the test rather than inter-marker variation), both a wider spread of scores; and test items of middle difficulty increase reliability.

Killen makes the point: “The important challenge for teachers is not to construct valid test items *per se*, but to construct test items, administer tests, mark and interpret results in ways that will allow valid inferences to be made about student learning” (Killen, 2003). In this instance, Paper 1, the R-Type MCQs predominantly required the students to remember unistructural, factual information. Whilst such knowledge is an essential constituent in making rational prescribing choices, it does not test the complete skill set and thus we cannot make predictions about students’ prescribing learning solely from this test. Questions in Paper 2 involved evaluation of procedural and conceptual knowledge and required responses at the unistructural, multistructural and relational level. This was a more valid test of the skills of rational prescribing, and inferences regarding students’ ability to evaluate data can be drawn from student performances. When considering the range of prescribing skills tested in Paper 2, however, we see that the test performances cannot be used to generalise predictions of students’ prescribing competence, since the full array of prescribing skills was not tested here. Thus, in the final integrated examinations, we do not fully explore the ways in which students organise, sequence and defend their knowledge claims of rational prescribing and therefore we cannot make confident predictions about the prescribing proficiency of the doctors we produce.

⁹ In both a legal and professional sense, since fitness to prescribe medicines is conferred with the MBCh degree as a judgement of the adequacy of rational prescribing training.

5.4 Student Perceptions Of Curricular Delivery Of Rational Prescribing Skills

I initiate this discussion of student perceptions of what counts as valid prescribing knowledge by utilising a framework suggested by Basil Bernstein (1977) to explore the delivery of the educational process.

As explained in Chapter 2, the GEMP delivers its curriculum as an integrated code, the better to enable construction of a knowledge structure which facilitates managing medical problems in a real-world sense. Classification is deliberately weakened through horizontal integration of silos of disciplinary knowledge into a curriculum delivered as body system blocks. In addition, the curriculum designers also claim a weakened frame, since, in the PBL process and later in the ward situation, students are supposed to identify their own areas of weakness and seek to remedy these deficits themselves. Thus the curriculum is designated “student-centred”, with the onus on the student to manage the selection, and pacing of their learning in relation to what they perceive they need to know.

How then does a student decide what content she needs to study in the GEMP? Whilst the answer to this question should surely encapsulate the culturally and socially mediated question “what knowledge does one have to know in order to be a proficient doctor?”, the reality is more prosaic: As a result of the policy of widened access into the GEMP, it was acknowledged that there would be underprepared students¹⁰ who would not manage to negotiate the “student-centred” approach to learning unaided. A set of learning objectives was thus devised, by which it was intended that students guide their studies. In addition, it was decided that in GEMP I and II, the problem-based-learning sessions and theme sessions would be augmented with 6 formal lectures during the week and provision of a set of printed information relevant to the case organised as “learning topics” – the better to explicate content of the problems. From this it can be seen that framing of the curricular content in the first two years of the programme is not as weak as was originally proposed, since there is a firmly delineated structure and schedule for its transmission and a defined “blueprint” for its examination based on the stated learning outcomes.

¹⁰ For a fuller exposition of the factors affecting underpreparedness in students entering the realm of higher education in South Africa, see Slonimsky, L. and Shalem, Y. (2004) “Pedagogic responsiveness for academic depth” in Griesel, H. (Ed.) *Pedagogical Responsiveness: Case studies in Higher education* (Pretoria SAUVCA) pp81-99.

5.4.1 Quantity of Basic Pharmacology Delivered in the Curriculum

It seems, however, that this structure did not meet the students' needs in recognising the necessary basic knowledge to later develop rational prescribing skills. When asked, as final year students, whether the basic science content delivered in the first two years of the programme was sufficient to enable eventual development of rational prescribing skills, the answers were uniformly negative (Table 8). Sixty seven percent of respondents expressed the view that there were not enough lectures on the basic pharmacology of drugs and 60.2% concurred that there were insufficient learning topics. Of interest is that whilst 72.9% of students preferred lectures, 16.3% found it easier to learn pharmacology from learning topics (reported in question 10). This percentage may reflect the students who negotiated the weaker classification and framing of the curriculum to their advantage, preferring self-study over teacher-centred didacticism. The preference of the majority of respondents for lectures could reflect general insecurity with the weakened frame, with students preferring to be told "what is important".

Q10.	%P	%N
I find it easier to learn pharmacology from learning topics than from lectures	16.3	72.9

8. Rate the QUANTITY of the following in relation to learning about drugs in GEMP I and II	%P	%N
Lectures on the basic pharmacology of drugs	2.1	67.0
Lectures on the use of drugs in clinical practice	0.0	93.5
Learning topics on the basic pharmacology of drugs	5.4	60.2
Learning topics on the use of drugs in clinical practice	1.1	90.3
Patient management information in terms of drug use in PBL sessions	0.0	89.1
Theme sessions on prescribing issues	2.2	89.2
Electronic learning opportunities (computer-based tutorials, problems, practice questions) regarding pharmacology	0.0	92.5

With regard to learning about drugs in clinical practice in GEMP III and IV (see Table 9 below), it was apparent that although tutorials were delivered on information retrieval and evidence-based medicine, most students felt these were insufficient. In addition, 92.5% of respondents reported a lack of tutorials on clinical use of drugs and 89.1% noted a dearth of tutorials on rational prescribing. This student contrasted the lack of learning opportunities for rational prescribing with other content delivered in the curriculum:

- “More time is spent on community doctor and PPD themes than on pharmacology and these themes are repeated in GEMP III and IV, we have no practical sessions on prescribing issues or skills at all in GEMP III and IV”

Table 9: Responses To Question 9 In The Student Perceptions Questionnaire		
9. Rate the QUANTITY of the following in relation to learning about drugs in GEMP III and IV		
	%P	%N
Lectures on the use of drugs in clinical practice (med school days)	0.0	87.2
Learning opportunities during ward rounds	2.2	46.3
Tutorials on drug use	0.0	92.5
Tutorials on rational prescribing	1.1	89.1
Tutorials on information retrieval	8.9	53.4
Tutorials on evidence-based medicine	21.6	39.5

Whilst a paucity of formal learning opportunities such as tutorials could occur because of the volume of clinical work in GEMP III and IV, the finding that 46.3% of respondents perceived that ward rounds did not realise sufficient opportunities to learn about clinical drug utilisation is of concern. Several reasons for this could be suggested from students’ free-text responses:

Firstly, students perceive that the focus of clinical training is on diagnosis, not drug management.

- “in GEMP III you don’t have to know management and in GEMP IV diagnosis is still the most important thing”

Secondly, students’ understanding of the knowledge structure of theoretical basic pharmacology may be insufficient for them to interpret the qualified doctor’s comments on drug management, and to develop their own understanding by looking up the relevant drug management after the ward round.

- “in the medicine block i didn’t understand any of the drug names they said so i couldn’t follow up”

In the third instance, the hierarchical forum of a ward round does not provide optimal conditions for learning about rational prescribing, and students prefer to ask an intern/registrar to help them on an individual basis.

- “worst experience was inability to choose the appropriate antibiotic for meningitis and i was reprimanded that next year i’ll be a doctor but i don’t know how to treat meningitis. i was so embarrassed afterwards I had to ask”

Congruent with these findings, Maxwell and his colleagues (Heaton *et al*, 2008) identified insufficient content in both basic and clinical pharmacology learning opportunities as instrumental in constraining development of rational prescribing competence in medical students.

A finding which requires closer scrutiny was that more than 90% of respondents felt that in GEMP I and II there were insufficient lectures and learning topics relating to drugs in clinical practice. As will become evident later in the discussion of the sequencing of the curriculum (in section 5.4.2. below), the teaching of basic pharmacology (how drugs work) usually precedes instruction in clinical pharmacology (the choice of drugs in the management of specific illnesses). In our case, basic pharmacology was taught in GEMP I and II (the predominantly “pre-clinical” years) with the intention that students apply this knowledge in making therapeutic decisions during their clinical training (in GEMP III and IV and their eventual clinical practice).

The report that 89.1% of participants considered patient management drug information in PBL sessions to be deficient adds further light on this discussion. The focus of pharmacology lectures, learning topics and examination questions in GEMP I and II is on acquisition of a

body of knowledge concerning drug mechanisms, not on the use of medicines within the clinical setting. However, the principal mode of learning in these years is PBL, thus students are expected to apply this basic pharmacological knowledge to their clinical case for the week during the patient management session. A large percentage of students recognised their difficulty in accomplishing this contextualisation and commented on the absence of formal clinical pharmacology teaching in GEMP I and II. An additional explanation as to why students would consider it an advantage to learn both basic and clinical pharmacology concurrently suggests itself from the free-text responses: This student appears to consider the basic pharmacology unrelated to clinical therapeutic decision-making:

- “The pharmacology of how the drug works is not really important for prescribing- what is more important is knowing which drug to choose for the illness”

This response raises the issue of how students construct and use their pharmacology knowledge in preparation for developing rational prescribing skills – a question which will be discussed in the following section.

5.4.2 Sequencing of Delivery of Basic Pharmacology

The problem of sequencing the delivery of basic pharmacology in a medical curriculum as a basis for development of rational prescribing competence has been extensively debated. The most commonly cited argument (especially within “traditional” curricula which delivered disciplinary knowledge as individual “silos”) is that if pharmacology is taught as a pre-clinical science, it is difficult for students to connect the basic science with clinical relevance at a later stage (Regan-Smith *et al.*, 1994; Vernon and Blake, 1993). In this format, the medical students learn about the effects of drugs before learning about diseases, and find difficulty in applying this basic knowledge to clinical problems.

Jessica Muller and her colleagues (2008) cite the advantages of both integration of disciplinary knowledge and delivery of the material as PBL in conveying sufficient basic pharmacology to enable eventual rational prescribing competence. They claim that such curricula circumvent the pre-clinical/clinical divide since PBL contextualises learning about drugs in relation to disease (Barrows & Tamblyn, 1980; Schmidt, 1993), and that horizontal

integration of disciplinary knowledge in relation to a designated problem enables construction of a network of knowledge which can be retrieved in the management of similar problems. Thus, in GEMP I and II, both disciplinary integration and use of PBL should enable students to acquire sufficient basic pharmacology for eventual rational prescribing competence.

It is apparent from students' comments that this is not the case. A major theme that emerged from student comments concerned the sequencing of pharmacology teaching:

- “The lectures were good but they were inappropriate during GEMP 1 and GEMP 2 i.e. they made no sense at that time, so I forgot what I learnt.”
- “emphasis should be placed on pharmacology in Gemp IV, not earlier”

More than just identifying the problem with sequencing, the following student develops a reason for the difficulty.

- “To much theory in gemp I and II and then no link with gemp III and IV where we can put it into practice.”

The recognition that students perceive a division between theory teaching in GEMP I and II and practical application in GEMP III and IV is an important finding (as noted in section 5.4.1. above). Whilst 28.6% of respondents felt that they would be able to apply their learned theory to clinical practice, 58.3% of participants claimed that the pharmacology theory learned in GEMP I and II was not of value in making prescribing choices (reported in question 10 below).

Q10	%P	%N
I can apply pharmacology learned in GEMP I and II to making prescribing choices in GEMP III and IV	28.6	58.3

The majority of students commented on their learning of basic pharmacology in a negative sense, incorporating phraseology such as “making no sense”, “easily forgotten”, “not applicable to patients” and “useless learning of lists”. This is of concern since, by utilising PBL, the pedagogic structure of GEMP I and II was intended to contextualise basic science learning within a clinical framework, and encourage incorporation of factual knowledge into

the students' wider network of understanding – This is plainly not occurring for pharmacology. Muller (2009) advances a line of reasoning that explains the failure of PBL to grant students epistemic access (see section 2.3.3.3 for a fuller account). In his discussion of the use of PBL in medical curricula he notes:

“Its proponents are clearly trying to bend the medical stick towards the contextual side by emphasising the contextual problem to be solved rather than the disciplinary knowledge to be learned.” (Muller, 2009:219)

Applying Muller's idea, we see that the contextual approach of PBL facilitated the learning of pharmacology in GEMP I and II as discrete rather than integrated knowledge, relating only to the problem of the week and not generalisable into abstract theory. Maton (2009:45) calls this “segmented learning”, since this type of knowledge acquisition restricts application to other contexts. Thus, when the students had need of this basic knowledge for application in GEMP III and IV, they found it difficult to transfer, since they had not learned principles, but rather “bundles of facts” resulting in the negative perceptions of the usefulness of their knowledge in making therapeutic choices.

Returning to Bernstein's (2000:157) original description of the two types of knowledge structures within the vertical (or specialised) discourse, it seems that instead of students developing their knowledge in accordance with the hierarchical nature of a vertical knowledge structure, integrating their knowledge towards development of principles, they learned detached items of content reminiscent of a horizontal knowledge structure. This occurred initially in GEMP I and II where the pharmacology content was learned in relation to the context of the problem and was reinforced in GEMP III and IV, where the practical context of therapeutic decision-making was learned “as a formula” and could not be generalized to other situations. Wheelahan (2009:236) notes this phenomenon in relation to competency-based training. She claims that “authentic learning in the workplace” provides students “with access to specific content in disciplinary knowledge rather than the disciplinary system of meaning” and this constrains their ability to apply their experience in different contexts.

Answers to question 24 (below) provided further insight into this debate.

24. How much do you identify with the following opinions
--

	%P	%N
Pharmacology involves learning lists of effects and adverse effects	67.9	27.4
Pharmacology knowledge builds on itself (knowing one basic fact can help you to learn other related info)	69.9	14.5

Nearly seventy percent of students recognise that pharmacology knowledge builds on itself however, their realisation of this knowledge is as separate lists learned (with 67.9% of students stating that this is the required mode of learning). My interpretation of this dichotomy is that although students may intellectually appreciate that learning of pharmacology could generate a vertical knowledge structure (and thus answered this question positively), the reality of what is valued in the ward situation and examination questions influences them towards segmented learning of drug utility and lists of adverse effects.

Davis' (2001:139) critique of high stakes examinations provides an explanation of why this could be so. He asserts that "high levels of reliability are essential in high stakes assessment", since these marks are used as comparators, and for advancement and standard setting for graduation and thus must be seen to be accountable. However, in the quest for improved reliability, educators restrict their test construction to demonstrate competence – not to reveal the network of connections and assumptions that underpin the development of a "rich web of knowledge". By stipulating outcomes, then directly testing those skills, reliability is ensured, however the validity of the assessment is reduced, since the test does not probe the student's underlying knowledge construction. Thus Davis contends that testing by outcomes leads to "teaching appropriate to the test" and affects the eventual structure of the knowledge that is built.

Within the context of GEMP III and IV, every block examination is a high stakes event, since a student has to pass the examination to progress on to the next block. (If a student fails a block overall, they have to repeat the block immediately). Thus, progression and eventual graduation is dependent on each examination session. Applying Davis' theory in this context we see that students are aware of the defined objectives of the curriculum and thus they structure their learning in order to demonstrate the required outcomes. Since it is a much harder task to design a reliable assessment that tests the conceptual network of understanding required to prescribe rationally, test questions have been contextually designed – and thus

they test separate “bits” of knowledge, rather than probing the student’s ability to organise, sequence and defend knowledge claims. In response, student learning develops as a horizontal knowledge structure, since this is demonstrably what is required to pass the exams. The following student comment provides evidence for this analysis:

- “I think it would be a good idea to make pharmacology more than learning about pharmacodynamics and pharmacokinetics, and make it more practical to prepare the medical student to prescribe safely and confidently in their clinical years and after they have graduated.”

Pharmacokinetics and pharmacodynamics are the major components of the structural spine of a vertical knowledge structure of pharmacology. Knowledge of these two sub-disciplines allows the most practical construal of information concerning any and all drugs in relation to how the drug works in the body and then how the body acts on the drug. By inferring that backgrounding of pharmacokinetics and pharmacodynamics would render drug information more practical, the student displays her lack of understanding of the basic principles (and thus the verticality of the knowledge structure) of pharmacology. She has clearly learned bits of information that remain unlinked in her system of understanding of the discipline.

It is interesting to note here that 27.4% of students did **not** agree that pharmacology involved learning lists of effects and adverse effects. This could be indicative of a group that recognised the principles of the discipline from the content offered and developed a more conceptual framework for their learning. This percentage is of a comparable order with the 28.6% of students (in question 10 documented above) who claimed that they **could** apply their pharmacology knowledge learned in GEMP I and II to making prescribing choices in GEMP III and IV. Evidently, the contextual nature of an integrated curriculum delivered through PBL, then clinical exposure **does** enable some students to construct an appropriate theoretical framework for rational prescribing. This is highlighted in the student comment below:

- “most people hate pharmacology but i enjoyed this part of my training the most and i found that the lectures helped me the most and i always referred to them when in need and i feel confident with most drugs.”

This is indeed a positive note on which to initiate the discussion of additional factors identified by students which enabled or constrained their development of rational prescribing competence.

5.5 Additional Factors Which Students Identify As Influential In Their Learning Of Rational Prescribing Skills

In addition to the curricular themes identified above, two issues predominated when considering student opinions concerning how to improve student access to rational prescribing skills. The first involved comments relating to quantity and type of assessment and the second related to learning-through-action and professional identities.

5.5.1 Student Perceptions Concerning Examinations

Regarding evaluations, students felt that rational prescribing was under-assessed in the curriculum and that foregrounding assessment of the constituent disciplines as well as the blended professional skill would lead to increased student competence. The opinion that prescribing was poorly appraised was frequently voiced:

In part answer to question 10:

Statement	%P	%N
I feel that assessments in pharmacology during my course thoroughly tested my knowledge and skills in this area	2.2	85.7
I feel that assessments in prescribing competence during my course thoroughly tested my knowledge and skills in this area	4.4	88.1

Eighty eight point one percent of students felt that the assessment of prescribing competence in the course did not test their knowledge and skills. The free-text responses highlighted this finding:

- “what prescribing assessment??!!” [Student’s own punctuation]

In the following comment, the student clearly identifies that only one prescribing skill was tested. This is congruent with the skills expected in the final integrated examination as discussed in 5.3 above.

- “all you have to do is get the drug right at the end of presenting the patient”

This and the following student comments are representative of a common theme in the responses, that acquisition of diagnostic skill is paramount in GEMP III, and that rational

prescribing decisions, although expected in GEMP IV, are rarely tested formally (this is briefly mentioned in section 5.4 above).

- “All exams from GEMP 3 blocks should examine pharm. therapy for patients, currently only obstetrics includes this as part of the exam and a large proportion of management is ignored in this clinical year”

The prevalent opinion seemed to be that more formal teaching *and testing* of prescribing skills in GEMP III and IV would improve access to the skills of the region. (I will return to this idea at the end of this point where I consider students’ suggestions for better prescribing learning).

This student articulated the prevalent theme that the quantity of assessment and the type of questions assessed can motivate learning:

- “Would have liked eg small weekly pharm tests, as, say what you like, it's tough to study pharm consistently without some tangible goal/outcome to work toward and measure yourself against, whatever your supposed academic maturity.”

Several issues are raised by this comment: Firstly, whilst paying lip-service to the concept of academic maturity, this student clearly feels that a stronger curricular frame with respect to assessment of core knowledge necessary for rational prescribing would have assisted her learning. This preference for teacher-driven rather than student-centred pedagogy could reflect a lack of confidence in her own skills to identify important learning issues for rational prescribing, since the obvious professional outcome of patient safety through competence seems beyond her current objective-driven focus.

The cynicism expressed with regard to self-motivation within the PBL system is disturbing. Self-assessment requires the development of metacognition (Gipps, 1999:374) to allow accurate judgment regarding self-analysis and to supply the added impetus of self-motivation. The idea of becoming a self-motivated learner of rational prescribing skills is an important one. Bearing in mind that the formal teaching is based on sections of the EDL, which is itself a restricted list, students are not taught about a wide range of drugs during their medical school years. The idea is to enable them to construct knowledge structures with which to make evaluative decisions concerning *any* medicine which they encounter in professional

practice (Aronson, 2006). Thus the basis for their continued professional learning is determined by the connectivity of their prescribing knowledge structures in relation their self-motivation to learn about the use of new medicines. Thus, whilst factual knowledge is necessarily a basis for rational prescribing practice, the deeper, more intuitive structure derived from self-constructed knowledge, and, more importantly, the ability to reflect on that knowledge, is supposed to afford the student greater insight into correct prescribing decisions and continued professional learning (Garbutt *et al*, 2003).

Howie (2000:247) claims that the capacity for inducing metacognition in students has a positive impact on clinical ability, but is a construct for which it is concomitantly harder to test. Interestingly, one student had developed sufficient self-reflection to report this insight in relation to her learning of rational prescribing:

- “ if you think about it it is just something you have to spend time on – since you have to know it otherwise you could harm a patient, but you will never see it in an exam.”

In direct contrast, a more common response was to comment on how the lack of assessment influenced lack of motivation to learn:

- “In GEMP I and II when writing exams only 1/2 questions were asked on pharmacology so as a student (when everthing is exam orientated) it was wise not to concentrate on all the pharmacology when one knew that only 1/2 questions would be asked in the exam. It is a waste.”

This comment revives the issue discussed in section 5.1.3 above; that students are aware that they can pass the integrated exam without answering the pharmacology questions. The unsettling factor here is the lack of metacognitive reflection on the ultimate goal of the learning (rational prescribing practice) in favour of a learning-to-the test approach; evidence of Davis’ theory in practice.

Question 11 asked students if they felt that having a separate examination in pharmacology would help them to improve their prescribing skills.

11. This question is about what you think influenced your learning of prescribing		
	%P	%N
Having a separate examination in pharmacology would help me to improve my prescribing skills	70.6	17.4

Seventy point six percent of students responded positively to this question, highlighting firstly that students recognise the link between the basic disciplinary knowledge and the applied clinical skill, but acknowledge that the quantity of assessment is insufficient to test the knowledge meaningfully. This question did not interrogate perceptions of the types of assessment, however Biggs (2003) claims that there is a lack of constructive alignment if either the form or content of the exam is not congruent with the teaching and learning activities and the original objectives. In this case, whilst many students seem to recognise that a rich disciplinary knowledge would enhance their performance of the complex skill, the dearth of summative assessment sends the message that it is not a current priority to learn this knowledge.

Tobaiqy and colleagues (2007) raise the issue of formative assessment as a means of developing the students' understanding of the requirements for practice. They advance the idea that assessment should ideally be incorporated with teaching, such that the assessments themselves offer learning opportunities. In this situation, errors provide insight into students' previous knowledge constructions, and also allow the teacher to redefine curricular aims with respect to areas of student capability. Several students noted that formative feedback on their prescribing decisions in the wards was helpful and that lack of feedback caused insecurity and frustration.

Positive comments concerning formative feedback:

- “ in the HIV clinic during paed, the dr gave a quick tut and then we saw patients together and made me work oyt what drug to prescribe and I had to calculate the dosage. I learned so much.”
- “lucky there was always an intern or reg on hand to prevent mistakes from impacting on patients. They help you to learn.”

Negative comments concerning lack of feedback on prescribing decisions:

- “Being left alone in clinics to manage patients and prescribe on my own, with no supervision. Its not supposed to be like this!”
- “During the IPC block we were largely unsupervised and had to make most of the prescribing decisions for ourselves and often for the nurses as well when they came to us for advice. The lack of supervision mean that we often made the wrong choices in what antibiotic we used as we had only SAMPF to consult. I found out

later that many of the medications I prescribed were wrong for the treatment of those conditions and others would have been better. Not sure how it will be next year.”

Related to the idea of feedback shaping learning, students expressed the opinion that prescribing was best learned by having to do it in the real-life situation. They claimed that their skills developed initially through reading patient charts and watching others prescribe, and then through prescribing for patients under supervision of a qualified practitioner. This raises the notion of “situated learning” as a model for exploring the development of competence in rational prescribing.

5.5.2 Situated Learning

Within models of medical education, active apprenticeship was a recognized historical mode of transmission of the profession (Calman, 2007:45). With the ascendance of constructivist approaches to learning in medicine, it is of interest to explore the various frameworks offered by educational theorists for this practice (eg Brown *et al*, 1989; Lave and Wenger, 1999; Gee 1989). The central idea is that through socially mediated means, learning occurs both intentionally and unintentionally through students’ participation in their field of practice. Through socialization, spending time with practitioners of the discourse, students can be inducted into ways of doing which result in enculturation into the disciplinary practices.

Brown, Collins and Duguid (1989:39) explain that within this paradigm, teachers can advance learning by “making explicit their tacit knowledge or by modeling their strategies for students in authentic activity.” Students then attempt the tasks under supervision, and eventually, they are enabled to practice the skill independently. In this fashion, students develop “ways of knowing and doing” that reflect the performance of both the instructional discourse (through the formally delivered curriculum) and the regulative discourse “which refers to conduct, character and manner” (Bernstein, 2000:13).

Lave and Wenger (1991) hypothesize that learning normally occurs as a function of the activity, context and culture within which it is situated. They describe the social interaction implicit in this system as “legitimate peripheral participation (LPP) within a “community of practice” (COP). In this view, learners, through processes such as modeling, mentorship and

implicit learning, move from the peripheral position of newcomers to the beliefs and practices of the community to an enculturated position of “oldtimer”.

For James Gee (1989), this process of apprentice-style learning is known as “acquisition of the Discourse” where “Discourses are characteristic ways of talking and writing about, as well as acting with and toward, people and things.” It is thus evident that Gee believes that acquisition of the Discourse requires more than passing examinations on knowledge content; it involves developing the recognisable role or *identity* of an adept of the Discourse.

Thus, many students commented that their learning of rational prescribing was facilitated by participatory activity:

- “I learnt most in ipc: actually looking up drugs,fetching them out the cupboard&handing them to patients”
- “being on intake and ward rounds and doing the actual writing of a prescription in a bed letter after being told what to write by the registrar. you only remember it after you've written it a couple of times”

This student highlights a more personal interaction where her understanding was advanced beyond that which she was capable of alone, by interaction with a more experienced “other”. This is the basis of a social theory of learning advanced by Vygotsky (1978) where learning occurs in the “zone of proximal development” (ZPD) through semiotic mediation. The ZPD is an area of possibility where a students’s capability can be stretched through interactions which “scaffold” (Moll, 1990) or “mentor” the progress. Vygotsky, like Gee posits that it is through acquisition of language appropriate to the discourse (and to the conceptual structure of the discourse) that the student develops. Students are enculturated into the community of practice of the teaching hospital hierarchy, where much of their learning occurs from emulating those more senior in the ranking (in both the instructional and regulative discourse). Thus, they learn both the practices and the professional identity of doctors by legitimate peripheral participation.

It is interesting to find evidence that students have developed the traditional professional identity of doctors being the gatekeepers of prescribing in relation to other allied medical professionals.

- “With respect to nurses, physios and the allied health professionals, you should not be prescribing unless you are qualified to deal with the negative consequences of your treatment (including upper GI bleeds due to NSAIDS!!)”
- “doctors prescribe it cos they know it!!!! We learn more about medicines than any of the allieds”

This is an attitude at odds with the current approach to patient care within a multidisciplinary framework, and also fails to acknowledge that with the existing scarcity of qualified professionals in the healthcare arena, all medically trained professionals will have increasing responsibility for the management of medicines. It is as if the students feel threatened by the “loss” of a position of power (which they have, as yet, incompletely attained).

Several students also conflated the professional identity of pharmacologists, those scientists actively engaged in extending the knowledge base of the discipline of pharmacology, with pharmacists, allied medical professionals with expertise in manufacture, storage and dispensing of medication. Whilst pharmacists have a strong therapeutics grounding (in the applied use of medicines), pharmacologists do not, and thus pharmacologists confine their teaching to the basic theoretical concepts.

- “Doctors can teach us practical points etc as opposed to more theoretical teaching by pharmacists”
- “being on IPC as my first block and only having GEMP 1 and 2 tedious pharm lectures to try and remember. let doctors teach pharmacology to medical students, that way we learn it from a doctors perspective which is more practical than from a pharmacist”

To extend the metaphor of the ZPD, clearly scaffolding built by qualified doctors to extend the learning path of students is preferred to the constructions of all others, outside of this delineated community.

With that in mind, I conclude this section with some student recommendations for improving access to rational prescribing skills. Many students identified a need for more formal “prescribing training” in GEMP III and IV. They also indicated that they used the South

African Medicines Formulary (SAMF) and Essential Drugs List (EDL) as primary sources of information in assisting them to make prescribing decisions.

- “IPC block was very useful in throwing us in the deep end and forcing us to read the SAMF and EDL, but I would have appreciated sessions on prescribing and common mistakes before going on this block.”
- “It would be really helpful if we could have a course in prescribing at the beginning of GEMP 3, because then we would be prepared going into the clinical years. Thank you!”

Rubin (2006) contends that the theme of action-driven learning supports his argument that prescribing is a proficiency best learned during the internship, where newly qualified doctors have ample opportunity to practice this skill under supervision. I see three potential difficulties with this position: Firstly, if prescribing is *only* learned by modeling, then students’ prescribing skills will only be as good as their mentors’, since they will have little conceptual understanding of the basis for rational choices. In this scenario, the volume of unconnected knowledge would be enormous, since much of the practice would have to be learned by rote. Teaching of theory that contributes to development of a “region” provides essential structures to support execution of the complex skill. The question here is “how does theory need to be taught in order for the student to develop this conceptual structure?” Ross and Loke (2009) recently reviewed the literature for trials of educational interventions to promote rational prescribing, and concluded that whilst many educational interventions are reported to improve student competence, there is a pressing need to investigate whether such improvements extend beyond the training, into the realm of clinical practice. Likic and Maxwell (2009) offer the homiletic that preparation and energy of staff will improve students’ prescribing competence:

“Medical education has changed greatly in recent years, often for the good. However, it is a matter of regret that specific courses in clinical pharmacology and therapeutics, the discipline that underpins safe and effective prescribing, have been lost. There seems to have been a prevailing view from some that this area of learning will ‘take care of itself’ as students are exposed to the clinical environment. This has clearly proved to be false. We believe that learning in this area needs to be carefully planned and enthusiastically led for students to achieve the greatest benefit.” (ibid)

The second reservation that I have about students learning the majority of their prescribing skills during their internship is a practical one. Within the very constrained services and staffing of the academic hospitals, it is very difficult for every prescribing decision made by an intern to be checked by a more senior doctor. Thus, the ideal of “prescribing under supervision” may occur sometimes, but is not as dependable as it sounds. Thirdly, once doctors are qualified, what are the formal pedagogical structures in place to deliver and assess rational prescribing skills if they are only supposed to develop these during their internship? Webster-Wright (2009) completed her doctoral thesis on the concept of continuing professional learning in the medical arena. She comments that

“patent differences between learning as a student, within a controlled framework focusing on accessible outcomes, and learning as a professional have not been clarified” (Webster-Wright, 2009)

For clinical teachers, the added responsibility of teaching, in the face of the overwhelming demands of patient care is indeed a heavy burden – but one it seems that qualified doctors are mandated to carry if they wish to enculturate acolytes into the prescribing practices of the profession. When asked, in the final analysis, what was the most important factor in affording them prescribing competence, most students identified the influence of their mentors:

- “My learning has primarily been through watching what doctors write up, even in tuts [tutorials] drug mx [management] is hardly ever approached”
- “your prescribing is only as good as the doctor you are copying”

However for some, the formal structures of knowledge transmission remained opaque.

- “one is just meant to pick up the art of prescribing- there is no guidance”

If students only learn how to prescribe during their internship, how then is their competence assessed? In a progressively more audited society, the static standard of initial competence mandated by the HPCSA (passing the final exam) is not sufficient for ultimate practice. Today's doctors are increasingly confronted with the loss of exclusivity of their professional knowledge content; access to the internet plays a role in distributing previously privileged information, and, increasingly, patients evaluate the doctor's practice against recontextualised knowledge gleaned in their context (Podichetty *et al*, 2006). Doctors are questioned concerning herbal medicines, generic equivalents, novel/investigative drug therapies and

more, none of which is incorporated into the mainstream prescribing discourse (Jamshidi & Cook, 2003). This wide range of expected competence in comparison with the narrower spectrum of an intern's tested capabilities may contribute to "the gap between workplace demands and students' competence" mentioned at the start of this exploration and validates the need for further discovery in the realm of teaching, learning and assessing rational prescribing skills.

5.6. A Perspective on Developing Rational Prescribing Skills in Medical School

The preceding documentation and analysis of findings provides information about aspects of the development of skills in rational prescribing in the GEMP graduating class of 2008 at Wits medical school. The motivation for the study was to view such professional education from several perspectives, in order to inform suggestions for improvement of the process. Congruent with the theoretical frame guiding much of this work, I chose to interpret the study findings through Bernstein's lens of the power and control constituting knowledge production in the educational process. Bernstein (2000:114) describes the group of rules or procedures necessary for the conversion of knowledge into material (that becomes known to a student) as the "pedagogic device". This "device" can be considered within the framework of three hierarchically related rules; those pertaining to distribution, recontextualisation, and evaluation of knowledge. The distributive rules define and delineate access to knowledge; recontextualisation rules determine how curricula are constructed by conversion of knowledge from the field in which it was produced into useful knowledge for the field of practice and evaluative rules transmit criteria for the recognition of correct context in relation to the production of required texts which demonstrate realisation of the knowledge.

5.6.1 Distributive Rules

According to Bernstein (2000:13), distributive rules "mark and distribute who may transmit what to whom and under what conditions." Wheelahan (2009) explains that access to disciplinary knowledge can be influenced by the students' background. She clarifies that the ability to succeed in education can depend on "culturally acquired capacities" such as facility with abstract reasoning, ease of self expression and familiarity decoding text-based knowledge, depending on the students' family situation and previous schooling experiences. Within the GEMP, such pre-existing cultural capital privileges knowledge building, whilst learning is constrained in those who have yet to develop these skills.

Whilst the distributive rules that mediate epistemic (and even physical) access to students is of importance, of greater relevance to this study is the number of participants who have a stake in delivery of rational prescribing to medical schools: Since the rules of the pedagogic device are hierarchical, these contributors have direct influence on how the curriculum of the region is structured, the modes of pedagogy by which it is delivered and also, how to evaluate what counts as rational prescribing competence. For example, the economic policies of the government intended to reduce budget spending on medicine obliges practitioners to

constrain their prescribing activities to the EDL. The EDL thus becomes the curricular core for pharmacology content within the GEMP. The health professions' council of South Africa (HPCSA) maintains a tension with the University Faculty Undergraduate committee in that the HPCSA is responsible for the maintenance of professional standards of training and thus it can assess the exit standards of University graduates. The CHSE maintains a tension with the faculty undergraduate committee in that the CHSE is the body which assumes responsibility for the practical aspects of running the GEMP programme but curriculum and its delivery are ultimately the responsibility of the undergraduate committee. The division of pharmacology maintains a tension with the CHSE, since it is lecturers within the division who ultimately choose the specific material for delivery, which impacts on ultimate assessment within the GEMP. All of these players impact on the decisions which contribute to recontextualising pharmacology knowledge, clinical therapeutics and rational prescribing into the GEMP curriculum.

5.6.2 Recontextualising Rules

One of the major findings of this study is that there is a gap between the intended aims of teaching rational prescribing through the GEMP curriculum and how the students actually develop these skills. The choice of integration of disciplinary discourses into a contextualised curriculum, taught through the medium of PBL was intended to improve student access to actual medical thinking and decision-making skills, as in the real-world situation. According to student perceptions reported in this study, however, rational prescribing is largely inaccessible to some students since they are not building richly connected webs of knowledge and cannot apply the knowledge that they have learned to different situations. It seems that both disciplinary integration and PBL are constraining access to the requisite knowledge necessary for rational prescribing competence. In the clinical years, because basic pharmacology knowledge was learned in a contextualised manner, it became difficult for students to apply this knowledge to different practical situations, and they continued to learn clinical therapeutics in a compartmentalised manner for specific illnesses. The last weakness of delivery of the rational prescribing curriculum was that the current structure assumed that students would be able to apply clinical pharmacology knowledge (the use of drugs in illnesses) to prescribing for a *particular* patient. Thus, the study highlighted that the actual skills of rational prescribing were not actively taught or assessed in the GEMP. In trying to pinpoint why such assumptions have been made, it is evident that the tensions between many of the players (mentioned in the previous paragraph) could contribute to this situation. The

division of pharmacology sees as its responsibility the recontextualisation of basic pharmacology for medical students as the structure of the discipline, not the *applied* use of drugs. Clinicians on the wards report that they expect students to have a working knowledge of clinical pharmacology *before* they embark on ward work, but the division of pharmacology does not see this as a priority in their limited teaching time. The CHSE has not actively targeted this gap, since the nature of integrated examinations can obscure how students actually perform in rational prescribing. In recommending a review of the rational prescribing syllabus, therefore, it would be ideal to involve as many of the stakeholders as possible to identify strategies for recontextualisation of rational prescribing knowledge suitable for inducting medical students into the professional practice.

5.6.3 Evaluative Rules

Another consequence of the tensions between stakeholders in recontextualising of the field of rational prescribing is that the tensions are perpetuated in the evaluative rules. From this study it is evident that the medical school discourse with respect to assessment of rational prescribing skills is not the same as proficiency in professional practice. Successful students in the prescribing exam can be said to have mastered the discourse, not the professional practice. However, since the students have participated in the community of practice of prescribers in a peripheral way, they are aware of the demands of the professional practice, and they express this difference as uncertainty in their prescribing skills. The lack of opportunity for both formative and summative assessment of rational prescribing skills in a formal sense within the GEMP curriculum further constrains student access to the professional practice. This is of concern since, although students have opportunities to develop their prescribing skills during their internship year, the ultimate evaluation of their practice in this arena is the health of their patients – where far more is at stake than examination marks.

6. Conclusions

There was dissonance between the “exit-level” competence in rational prescribing skills as delineated by the University and student perceptions of their preparation and ability to prescribe. According to the standards set by the GEMP, 83.6% of students were competent in rational prescribing skills on graduation; however 66.3% of students reported feeling underprepared for prescribing responsibilities.

There was also a lack of alignment between the knowledge and skills set as outcomes and assessed in this region and the real-life practice of rational prescribing. This may have contributed to students’ lack of confidence in their prescribing skills. Analysis of the types of questions used to determine prescribing competence revealed that although questions in Paper 2 tested evaluative skills, the complex decision-making processes required for rational prescribing were not thoroughly tested by this assessment. Having participated in the community of practice of hospital doctors as legitimate peripheral participants, the students were aware of the demands of rational prescribing, and expressed concern regarding their competence.

Student suggestions to improve teaching and learning of rational prescribing skills foregrounded active learning from qualified doctors as an effective strategy. Introduction of formal (rather than opportunistic) teaching of clinical pharmacology was recommended in the clinical years. They proposed that the opportunity to practice and be tested on a range of prescribing competences could contribute to improved confidence in these skills.

This study highlighted the need for curricular review with respect to the delivery of basic pharmacology knowledge in GEMP I and II: The integrated nature of the curriculum delivered as PBL constrained verticality in the development of students’ rational prescribing knowledge structures. The resultant horizontal knowledge structures increased the apparent volume of the work and reduced its applicability in practice, since integrative principles were not deduced. The implications for lifelong learning of development of horizontal knowledge structures are sobering, since new prescribing knowledge would only accrue as discrete “information bits” rather than subsumption into an interrelated framework.

In GEMP III and IV students perceived a need for formal clinical therapeutics tutoring that builds up to activities which combine all the skills in order to allow students to practice and be assessed on rational prescribing. The study further emphasized the need to construct prescribing assessments that more closely resemble the real-world competence which they attempt to interrogate. To quote Maxwell and Walley:

“Simply providing a link between drugs and clinical conditions is insufficient to develop an appreciation of the complex considerations that surround the decision to prescribe.” (Maxwell & Walley, 2003)

6.1 Limitations of the Study

This was a descriptive study contrasting student achievement in a high-stakes assessment against student perceptions of rational prescribing skills, thus several factors should be considered when evaluating the veracity of possible conclusions: Firstly, with respect to the prescribing assessment, validity of the competence assessment could have been improved by inclusion of several different testing methods (including a practical test). Unfortunately, the format of the final examination did not allow for this and although 2 marks for competence were obtained, they were both from written examination components. Secondly, data obtained from the perceptions questionnaire arises out of a self-selected population (since responses were invited) and, despite a positive response rate of 67.8%, such data may not be representative of the entire class. It would have been helpful if the students’ schedule had allowed for focus group discussions or interviews to consolidate or explore some of the data obtained.

With respect to data analysis, it would have been optimal to correlate an individual’s competence mark with their perceptions of competence. However, the requirement of anonymity of the perceptions survey responses precluded any direct comparisons, thus a less specific group correlation was undertaken. In addition, the focus of the study was on qualitative data management, exploring reasons for the differences in performance rather than the statistical significance of the extent of such diversity. Although statistical inferences could have been calculated (especially from the examination marks), it was felt that their inclusion in this study would not add value to the focus of explanation and explication.

This study was conducted in a single class at one defined time-point, resulting in a dataset specific to this particular class in Wits Medical School. However, the issues raised concerning factors which affect prescribing competence are of national and global importance. Whilst conclusions cannot be generalized, the questions raised by this work will be of relevance to many others involved in the teaching and assessment of rational prescribing.

6.2 Recommendations

6.2.1 Curricular Structure

Pharmacology, as the knowledge base for rational prescribing is a factually dense discourse that can be intimidating for students to approach. Integration of designated “core” material into the delivery of GEMP I and II with the aim of transfer of this factual information into applied therapeutic skills in GEMP III and IV has constrained epistemic access. I believe that removing pharmacology deliveries from the integrated curriculum and re-introducing the subject as part of a rational prescribing course as a vertical strand from GEMP I through to IV would improve students’ access to the skills.

6.2.2 Pedagogy

The prescribing discourse would benefit greatly from improved pedagogy. PBL as a mode of delivery has shifted student learning towards surface approaches that limit the applicability of the knowledge gained. In addition, didactic lectures, although sometimes useful, should not be the primary mode of delivery since they induce student passivity with respect to discovery and understanding of the requisite knowledge, skills and behaviours. Active approaches including theme sessions and practicals involving discussing prescribing decisions with patients as part of communicating skills, critique of clinical trials involving drugs, appraising claims for new drugs and writing case reports containing discussion about therapeutic aspects could improve students involvement with different aspects of the skills involved. In addition students should have access to a web-based resource which ideally could incorporate animations and explanations on drugs and their use as well as contain a library of popular movies as a teaching tool to allow students to better understand some issues in prescribing eg clinical research on new drugs, bioethics, social and psychological aspects of drug therapy (Farre *et al.*, 2004).

6.2.3 Development of a Student Formulary

In developing this web-based resource, a list of around 100 medicines representative of the major drug classes outlined in the EDL should be identified and matched with their use in

common illnesses. This list could be used by students to prioritize their learning and to help them develop a framework for the rational usage of drugs in clinical practice. A full electronic formulary with appropriate links to discussions in clinic practice could engage students with discovery of their own prescribing knowledge structures.

6.2.4 *Role Models*

It is possible that doctors are unaware of the extent of their influence on the construction of students' personal approaches to therapeutics. Ideally, qualified doctors in the hospitals should participate in regular continuing professional exploration sessions which highlight such issues for discussion. In addition, it would be beneficial if units were open to the idea of occasional clinical pharmacology ward rounds – where patient management decisions were the primary focus. Also, the role of multiprofessional learning should be explored, since doctors, nurses, dentists, physiotherapists, pharmacists and clinical associates all have an investment in the rational use of drugs and could learn from each other in both the instructional and regulative discourses of rational prescribing.

6.2.5 *Assessment*

Assessment should provide a valid realisation of students' prescribing competence. Assessment activities could vary across the 4 year programme and could include review of drug sheets, participation in clinical management discussions, self-assessment of knowledge about core drugs, assessment of colleagues' prescriptions for drug interactions, written up case reports, communication about prescribing decisions to patients, analysis reports on clinical trials, and presentations on information about new drugs. The web-delivered platform could provide access to different variations of formative assessment which could encourage content learning. In addition, formal assessment of prescribing skills in practical examinations could increase students' confidence in recognizing and realizing the skills to be learned.

6.3 Future Research

This research has exposed many more questions for me than answers. Specifically to extend the findings of the present study, it would be instructive to contact this cohort again at the end of 2009 (the official internship year) or even further into the participants' careers to

determine perceptions and competence in rational prescribing after a period of clinical practice.

The current study focused on student perceptions and performance. It would be interesting to conduct a study from the point of view of staff involved in delivery of the prescribing curriculum, as well as various levels of the hospital hierarchy involved in student learning and performance on the wards.

There is room in this conversation to develop a study which could explore multidisciplinary learning of pharmacology and prescribing skills amongst those student healthcare practitioners who will have legal responsibility in prescribing. Combined learning of prescribing skills amongst medical students, dentists, nurses, clinical associates, pharmacists and physiotherapists could produce interesting data concerning professional identity and roles – aside from the direct effects on prescribing learning. Currently, each set of students is inducted into their approach to the practice separately.

There is a need to investigate rates, types and reasons for prescribing errors amongst interns and junior doctors in our hospitals. Both quantitative and qualitative studies are required to consider the situation in South Africa. Such studies could have direct impact on medical school curricula and continuing medical professional development programmes.

It would be interesting to explore prescribing practices of experienced medical specialists with a focus on the cognitive psychological processes involved in their decision-making methods and consequent implications for learning of this skill in junior practitioners.

On a practical level, the development of more varied pedagogy would provide an opportunity for comparing students' learning approaches and degrees of success of the different methodologies in developing rational prescribing competence. In tandem with this, a critical reappraisal of the sequencing and pacing of basic pharmacology, clinical pharmacology and applied therapeutics within the GEMP curriculum could provide the basis of a study to explore future students' rational prescribing competence.