A comparative study of examination performance at the five Deakin University School of Medicine clinical school sites.

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Table of Contents

TABLES

Figures

Summary

A critical lack of medical workforce has developed in rural and remote Australia over recent decades. Various efforts have been made to address this worsening situation, culminating in the quite recent rapid increase in the number of medical student places, within a significantly increased number of medical schools.

The Deakin University School of Medicine was developed as a rurally focused medical school, admitting its first cohort of students in 2008, and adopted several innovative approaches to medical education. This original research was designed to examine whether the school's decision to base its clinical education on small, dispersed, student cohorts, in rural settings disadvantaged students in comparison to the traditional large group tertiary clinical training setting.

A quasi-experimental design was employed to assess the students' academic performance at the five, geographically dispersed, clinical training sites within the medical school. An internationally validated questionnaire was also employed to provide quantitative analysis of the students' perception of their educational environment. Analysis of the gathered data indicates that not only are students, who were educated at the small rural sites, not disadvantaged, they appear to perform to a higher standard than those trained at the traditional tertiary site.

Declaration

I certify that this thesis does not incorporate, without acknowledgement, any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person, except where due reference is made in the text.

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Chapter 1. Introduction

Medical workforce shortage

Over recent decades an international trend towards medical workforce shortages has been identified (Australian Medical Workforce Advisory Committee, 1996, p.51). Australia is now firmly ensconced in this dilemma; particularly in rural and regional areas of the nation as acknowledged by the then Minister for Health, Mr. Tony Abbott MP, in the 2006 Deakin University Richard Searby Oration (Abbott, 2007). Successive Australian governments have attempted to combat this situation through both short and long term methods, such as: importing health care workers from abroad (Smith, 2008); bonding clinicians to defined 'area of need' positions (Medical Board of Australia, 2010, Smith, 2008); providing financial incentive programs for continued practice in rural locations (Jones et al., 2004); creating new medical schools (Joyce et al., 2007); and increasing student numbers within medical schools (Couper and Worley, 2010).

Deakin University School of Medicine

The Deakin University School of Medicine was established, in 2008, with the aim of addressing the rural medical workforce shortage. An important part of the approach is to provide students with a prolonged exposure to rural medical practice, via gaining their two years of clinical experience in a rural setting.

It has been shown that two clear contributors to addressing a rural and regional workforce shortage are admitting students from regional areas (Rabinowitz et al., 2001, Woloschuk and Tarrant, 2002) and training them in just such a setting (Eley and Baker, 2007, Wilkinson et al., 2003).

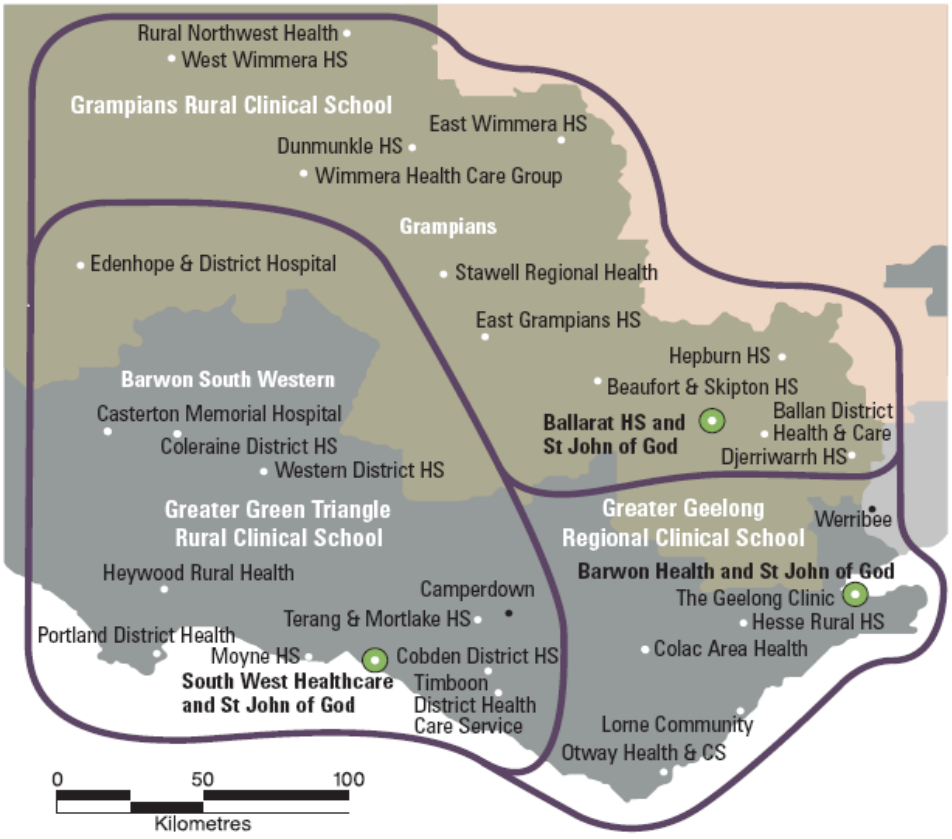
The Deakin University Bachelor of Medicine, Bachelor of Surgery degree is a four year graduate entry course which has been designed to address rural and regional medical workforce shortages. The aim is to produce, rurally inclined, 'work ready' doctors for General Practice & other specialist training, with an emphasis on: procedural skills, chronic disease prevention and management, and interdisciplinary learning (Deakin University, 2012).

The course commences with two years of pre-clinical studies centred on the Problem Based Learning approach to medical education, as described in "Problem based learning" (Wood, 2003), conducted at the Waurn Ponds campus. This is followed by a two year clinical school placement at one of five sites:

- Metro 1;
- Metro 2;
- Rural 1
- Rural 2; and
- Rural 3

One of these sites is the Integrated Model of Medical Education in Rural Settings (IMMERSe) program- which involves individual students undertaking a twelve month longitudinal integrated clerkship placement in a rural general practice during third year (Norris et al., 2009).

The clinical training sites are spread across south west Victoria, Australia, as demonstrated in the following map of Victoria, and the subsequent enlargement of the region.



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"The Rural, Remote, and Metropolitan Areas (RRMA) classification divides all Statistical Local Areas (SLAs) of Australia into three zones, namely metropolitan, rural and remote and a total of seven categories across these zones. The separation of rural and remote zones is determined using a method earlier developed by Arundell [12], by weighting five indicators that measure population density and straight - line distances to various population centres" (McGrail and Humphreys, 2009).

This classification system was the existing classification used within the Australian healthcare setting when the Deakin School of Medicine came into being, and therefore was the system employed by the University for the first two cohorts of students to enter the school. The classification system employed was subsequently changed, to the current ASCG-RA system, for the third cohort to enter the school. Where there is a comparison between metropolitan and rural sites, within this study, metropolitan refers to the sites within RRMA category 1-2 and rural, to those within categories 3-7

Structure of the Rural, Remote and Metropolitan Areas (RRMA) classification

Zone		**Category**
Metropolitan zone	M1	**1** Capital cities
	M2	**2** Other metropolitan centres (urban centre population > 100,000)
Rural zone	R1	**3** Large rural centres (urban centre population 25,000-99,999)
	R2	**4** Small rural centres (urban centre population 10,000-24,999)
	R3	**5** Other rural areas (urban centre population < 10,000)
Remote zone	Rem1	**6** Remote centres (urban centre population > 4,999)
	Rem2	**7** Other remote areas (urban centre population < 5,000)

Rural 2 is a medium sized rural city (pop. 33,300, RRMA- 3) with a 172 bed base hospital and a total of approximately 40 medical students, across years 3 and 4 of the Deakin course. The clinical school at Rural 1, a large rural city (pop. 98,700, RRMA-3), has a similar number of Deakin medical students, but also hosts University of Melbourne and Notre Dame University medical students. Metro 2, which is situated in the eastern suburbs of Melbourne (a capital city, pop 4.25 million, RRMA-1), hosts a small number of Deakin medical students, however, they are a small minority hosted by a major clinical site for Monash University medical students. Metro1 is a metropolitan centre (pop. 215,150, RRMA-2), with 120 Deakin medical students across the two clinical years of the course. Finally, Rural 3 sites are small rural towns scattered across south western Victoria, with hospitals staffed by local General Practitioners (RRMA-4 to 7)

All students, regardless of the clinical school they attend, undertake the same written curriculum, learning objectives and assessment. The clinical years of the course are divided into discipline based rotations, such as Medicine, Surgery, General Practice, and Women's Health. Each of these rotations have a written curriculum detailing exactly what topics and skills are to be covered. The approach to teaching this curriculum can vary from site to site; none more so than in the IMMERSe stream where students don't rotate through specific discipline terms, but cover all of the various discipline curricula across the entire year based in a single general practice. Despite the different approach, the specific topics to be covered remain the same, and all students undergo the same examination process, involving the same multiple choice paper, and the same Objective Structured Clinical Examination (OSCE).

The student admission criteria for the medical course are:

- the Graduate Australian Medical Schools Admission Test (GAMSAT); requiring a minimum overall score of 50, with at least 50 in each Section.
- the Grade Point Average (GPA) of the student's prior degree; requiring a minimum of 5.0
- an admission assessment interview in the Multiple Mini Interview (MMI) format.
- plus bonus admission points are awarded for:
    - rural/regional residency (place of residence in Rural, Remote, and Metropolitan Areas (RRMA) categories 2-7);
    - prior clinical experience (minimum of 1 year);
    - a bio-medical science or health major in the undergraduate degree; and
    - financial disadvantage during their undergraduate degree.

The definition Deakin School of Medicine uses regarding 'previous clinical experience' is "applicants who have completed one year of clinical practice as a registered health professional receive a 2% bonus. The following health disciplines will attract a 2% bonus: Chiropractic, Dentistry, Nursing, Midwifery, Optometry, Osteopathy, Pharmacy, Physiotherapy, Podiatry, Psychology, Occupational Therapy, Dietetics, Speech Pathology, Paramedics, and practitioners in Aboriginal and Torres Strait Islander Health, Chinese Medicine and Medical Radiation.(Deakin University, 2014).

As the 'clinical experience' bonus is assessed on Deakin's behalf by the Graduate Entry Medical School Admission System (GEMSAS), there are some further

qualifying details, as follows: periods of provisional registration do not contribute to the 12 month period of being a registered health professional; and future registration or employment cannot be considered. Applicants must have completed the full 12 months by the time they lodge their application with GEMSAS. Bonuses cannot be awarded to applicants whose 12 months clinical experience will be completed by the time the course commences as there is no way to guarantee that they will actually complete the clinical experience.

The school is very interested to see whether the strategy of using five separate clinical campuses provides good quality equivalence across the clinical sites. This study is planned to provide evidence regarding this question.

An innovative approach to medical education

The Deakin University School of Medicine is newly established, offering a post-graduate medical degree, with its first graduates having completed their studies in 2011. The school has a philosophy of producing' work ready' doctors for General Practice and specialist training, and is dedicated to addressing the workforce shortage in rural and regional Australia (Deakin University, 2012). With those goals in mind, from its inception the school has employed modern teaching concepts based around adult education pedagogy, problem based learning, the use of electronic media, and deploying small student cohorts to distributed clinical education sites. The Deakin University School of Medicine has never employed the traditional medical school approach to education, of separating the course into years of studying pre-clinical

medical sciences, followed by basing large numbers of students in a centralised tertiary hospital setting for their clinical education.

In recognition of the importance of assessing the appropriateness of this innovative approach to medical education, within this new context, a review of the literature was conducted to determine the most significant elements to evaluate of the approach to clinical education adopted by Deakin University.

Similar studies have been conducted at other medical schools that have had previous experience delivering a traditional medical curriculum which subsequently adopted problem based learning, longitudinal integrated clerkships, distributed education sites, and/or small group cohorts. Results of these studies support the implementation of the programs described in these studies, within an established medical education program.

Previous studies have indicated that the implementation of each of the individual educational innovations listed above have not disadvantaged the students participating in the new stream compared to those undertaking a traditional approach to medical education. The Deakin University School of Medicine approach differs in that it has adopted all of these new approaches to medical education from the inception of the course.

It was decided to study student assessment results in order to determine whether the school's use of these new approaches academically disadvantaged any of the students. Summative assessment performance is a widely accepted method of measuring a medical student's preparedness to graduate, and subsequently commence a medical

career (Hamdy et al., 2006). Accordingly, assessment performance is a commonly adopted measure of educational validity in published studies (Bianchi et al., 2008, Carney et al., 2005, Denz-Penhey and Murdoch, 2010, Hansen and Simanton, 2009, Hirsh et al., 2012, Power et al., 2006, Schauer and Schieve, 2006, Sen Gupta et al., 2010, Waters et al., 2006, Worley et al., 2004, Young et al., 2008, Zink et al., 2010).

An important influence on students' educational outcomes is their experience of the environment in which their learning occurs. To assess this the Dundee Ready Educational Environment Measure (DREEM) was employed, which is an internationally recognised, validated fifty question survey designed to quantify a student's perception of his, or her, educational experience (Roff et al., 1997). Measured within the total DREEM score are five subscales: perception of learning, perception of course organisers, academic self-perception, perception of atmosphere, and social self-perception.

Chapter 2. Literature Review

Introduction

A review of the literature was undertaken, via the "Web of Knowledge" and "Scopus" online data-bases, looking at English language research articles, from 1990 to 2012, that were concerned with medical student's assessment results, rural and metropolitan medical education, longitudinal integrated clerkships, distributed education sites, and small student cohorts. The search terms used were: academic performance, longitudinal integrated clerkship, rural clinical school, metropolitan clinical school, medical students, rural medical students, metropolitan medical students, urban medical students, academic results, distributed sites, compare, and examination performance.

The topics of longitudinal integrated clerkships, distributed education sites, and small student cohorts were chosen for review as they represent the clinical educational settings that have been instigated in the Deakin University School of Medicine. Deakin's medical students may undertake their clinical training in a rural GP clinic/small hospital setting, a regional referral hospital, or an urban/metropolitan tertiary referral hospital. Using the criteria of original research, involving medical student subjects, in studies related to academic validity, 15 articles were identified for inclusion in this review.

Nine of these investigations were conducted as cross-sectional studies at a single point in time, that is a year cohort of students, or part thereof, as they completed the relevant assessment of their individual medical school. There were five cohort studies and one descriptive study. All the studies were conducted prospectively. There were no

randomised trials, subjects usually self-selected by volunteering for their positions in the rural, or distributed sites; if positions were over-subscribed they were chosen by faculty, based on applications, interview, or both.

Longitudinal Integrated Clerkships

Over recent decades the patient length of stay in hospital has progressively shortened (Australian Institute of Health and Welfare, 2012). These "shortened inpatient stays, and the shift toward ambulatory diagnosis and management, have had a negative impact on student learning" (Norris et al., 2009, p. 902). The study by Olson (Olson, 2005) found that there are too few patients available to be assessed by medical students, at any one time, in tertiary hospitals, for students to gain extensive clinical experience. Further, exposure to appropriate undifferentiated cases has become increasingly limited by the sub-specialisation of units in tertiary hospitals, which has led to the consideration of clinical education models other than the traditional one of rotating through specialty placements in tertiary hospitals (Whitcomb, 2005, Ogur and Hirsh, 2009).

One such alternative model is the longitudinal integrated clerkship (LIC). This "continuity based, clinical medical education requires that the student stay in one place, with one set of faculty members and one group of patients, for an extended period of time" (Norris et al., 2009, p. 902). An example of this approach, which has been adopted by the Deakin University School of Medicine, is to post students to a single general practice for twelve months of their clinical placements. These students study the same curriculum as their hospital based counterparts, and sit the same exams,

with their teaching supplied by the General Practitioners within the practice, plus or minus visiting specialists.

Multiple studies of the implementation of the LIC have shown no disadvantage in academic outcomes for student participants (Denz-Penhey and Murdoch, 2010, Hansen and Simanton, 2009, Hirsh et al., 2012, Norris et al., 2009, Power et al., 2006, Schauer and Schieve, 2006, Worley et al., 2004, Young et al., 2008, Zink et al., 2010). "Standardized testing of the students who participate in these integrated clerkships has not demonstrated any significant difference from the traditional clerkships" (Norris et al., 2009, p. 902). Indeed, Worley, et al (2004) found, in their study spanning several years of Flinders University students, that the cohort of students studying in a LIC (with students based in a rural General Practice clinic for twelve months), and also, to a lesser degree, the cohort based in a secondary regional hospital , out-performed the tertiary hospital based cohort, in their shared end of year assessment.

Although the LIC participants did not perform as well as their colleagues in a traditional setting in the single discipline of Obstetrics and Gynaecology, the study by Zink, et al (2010), found equivalent academic performance between LIC students and those based in a traditional setting. They conclude "these findings support the growing body of literature that shows equivalency between the test performance of students trained in rural clerkships and traditional students"(p. 705). A further possible advantage of a longitudinal placement is the beneficial effect of the experience on the student's self-identification as a clinician. A theme that emerged from interviews reported in the study by (Denz-Penhey and Murdoch, 2008) was "students moved from theoretical knowledge to experiential knowing, with sub-themes relating to self-

directed learning, becoming sensitized to other cultures and subcultures, gaining clinical confidence, and a growing respect for the team care of patients".

Couper et al.(2011) identified difficulties in LICs including student isolation, from family and friend supports, peers and usual recreational activities; and faculty isolation, from education professional development and peers. They also found road safety can be an issue for distant sites; as can, dealing with problematic or distressed students. Student misconceptions relating to the variation in clinical settings between sites was identified in a further study which found "a commonly held belief was that students at other sites must be better off"(Couper and Worley, 2010, p. 35). Young et al (2008) similarly found concerns about isolation and the lack of specialist teaching, along with issues concerning limited patient profile in small towns with a specific patient population- such as a fit young population in a mining town, and the feeling that most new learning occurred in the first six months of a placement followed by repetitive presentations.

Finally, Norris et al. (2009) identified the "logistical management of these programs is complex, requiring frequent communications with medical school administration and site visitations for faculty development and training"(p. 905), and "increased costs may be associated with increased student travel, faculty travel, faculty development, additional staff needed to handle the increased logistical complexity, and other factors"(p. 905).

Distributed Education Sites

The use of distributed education sites is becoming more important as the sub-specialization of tertiary hospital units significantly limits the exposure of medical students to undifferentiated cases (Ogur and Hirsh, 2009, Whitcomb, 2005).This narrowing of training at the generalist level has been addressed at multiple medical schools by including rotations at smaller community hospitals and General Practice clinics. A study of just such an approach, the Mac-CARE program at McMaster University in Ontario, Canada, has found no academic disadvantage was suffered by the participants in comparison to their tertiary hospital based colleagues (Bianchi et al., 2008). In fact, this study found the distributed placement students "out-performed their peers on the post-clerkship OSCE", however the observation was made that "it is too soon to understand why, or even if, this is a stable phenomenon" (Bianchi et al., 2008, p. 69).

This approach broadens the range of patients available to be seen by medical students. It also serves to increase the number of clinicians available to teach the medical students, through the recruitment of private general practice and specialists rooms, along with primary and secondary hospitals, both public and private (Crotty, 2005). With the shorter admission times and quicker turn-over of patients in our modern tertiary referral hospitals, individual clinicians are finding they have less time available to devote to teaching the increasing numbers of medical students (Spencer, 2003). An increasing number of studies are finding teaching by a wider range of clinicians, through distributed education sites, is not academically disadvantaging the student

participants (Carney et al., 2005, Denz-Penhey and Murdoch, 2010, Schauer and Schieve, 2006, Sen Gupta et al., 2010, Waters et al., 2006).

Student anxiety became the major theme of a structured questionnaire, plus semi-structured interview, cohort study of the inaugural student group of the University of Western Australia Rural Clinical School (Denz-Penhey et al., 2004). This anxiety was fuelled by issues of social isolation from family friends, and peers; concerns about a possible lack of learning relevant to the curriculum compared to colleagues in the traditional urban stream; and the unstructured nature of attachments that did not consist of moving through rotations dedicated to individual disciplines. Despite this, a follow up report of the program's annual student and faculty interview based evaluation indicates that a predominant theme amongst students was satisfaction regarding their rural experience, despite some frustrations, and their academic results were equivalent to their urban peers(Denz-Penhey and Murdoch, 2009).

Another concern raised regarding distributed education sites was "the possibility of less robust supervisory structures in the smaller centres may mean that weaker students receive less support"(Sen Gupta et al., 2010, p.5).

Small Student Cohorts

Employing small student cohorts allows small group sizes in clinical settings, which affords smaller ratios of student numbers to patients, clinicians, and faculty; thereby, overcoming many of the concerns regarding students educational experience in the traditional tertiary hospital setting (Spencer, 2003). Denz-Penhey and Murdoch (2008)

report that several benefits can be derived from small cohort clinical education. They found a rural experience provided a challenging environment for students, requiring them to incorporate their conceptual learning with the management of patients with complex clinical conditions in the context of the reduced range of clinician and technical supports available.

The smaller the cohort, the closer the students come to true experiential learning as described by Kolb (1984). This may involve improved access to activities such as, clerking patients, performing simple procedures, inserting IV cannulas, recording ECGs, helping perform CPR, and writing case notes. In short, the students may experience being a part of the treating team, working in co-operation with the resident medical officers, nursing and allied health staff. This is a relationship which is very difficult to build in a tertiary hospital.

The optimal experiential learning for a medical student involves learning through the performance of activities providing ‘real work value’; that is, performing duties that are actually required of a health team member for the care of the patient. This is achieved in the rural GP setting, such as the Flinders University School of Medicine ‘Parallel Rural Community Curriculum’ (PRCC) program. This program is based on the premise that an individual medical student spends an entire academic year based in one GP clinic in a town where the local hospital is staffed by the GPs of that clinic. Due to the longitudinal participation in such a setting “students became part of the health care team and came to see patients in their own setting. They became actively engaged with patients of very different cultures providing learning that will be

beneficial to patients regardless of whether the young doctor ends up in a rural setting or chooses to stay in the city"(Denz-Penhey and Murdoch, 2008).

The only negative reports regarding small group cohorts, in the studies reviewed, was the possibility of inter-personal relationships causing stress interfering with the students' enjoyment of their placements. Problems such as housemates not sharing the domestic workload equally, pets and partners staying, different requirements for quiet or alone time, and relaxation activities(Denz-Penhey and Murdoch, 2009).

This review of the literature regarding assessing new approaches to clinical education of medical students in, LICs, distributed placements, and small cohorts, has demonstrated the need to understand the comparative academic performance in the new programs.

As the issue of potential negative effects upon the students learning environment in these new settings has been raised, it became apparent that a measure of the students' educational environment would be required to assess any potential impact on students' academic performance; and also, to inform the School of Medicine's program evaluation. Thus, a further literature review was undertaken to uncover the most appropriate measure of medical student educational environment. Search terms used for this review were: assess educational environment, medical students, and DREEM.

Assessment of Learning Environment

If we consider “learning is the process whereby knowledge is created through the transformation of experience”(Kolb, 1984, p. 41), then such experiential learning, of course, involves more than the immediate learning material presented to the student; the student’s physical, emotional, and social experience will have an impact on their academic performance and may be confounders in this study.

A literature search regarding the assessment of medical students’ educational environment discovered reports of multiple studies that employed the Dundee Ready Educational Environment Measure (DREEM) to the satisfaction of the authors (Abraham et al., 2008, Aghamolaei and Fazel, 2010, Al-Ayed and Sheik, 2008, Avalos et al., 2007, Dimoliatis et al., 2010, Riquelme et al., 2009, Rotthoff et al., 2011). The DREEM is an internationally validated tool for providing a quantitative measure of a student’s perception of their educational environment. It can “generate a ‘profile’ of a particular institution’s strengths and weaknesses”, and “make comparative analyses of students’ perceptions of education environments both within an institution and between institutions or between different cohorts”(Roff, 2005, p. 323).

Furthermore, in their systematic review of the literature regarding instruments used to measure health professions’ educational environment, Soemantri et al. (2010) concluded: “according to the data presented in the related articles, the DREEM is likely to be the most suitable instrument to be applied in undergraduate medical education settings. The validity had been established, and the instrument demonstrated highly reliable results consistently throughout its administration in different contexts”.

Thus, as the DREEM questionnaire has been chosen as the appropriate tool for assessing medical student educational environment in many previous studies around the world, and has been assessed as superior to other such instruments in a systematic review of the literature, it has been employed in this study to aid identification of possible confounding factors that may interfere with the interpretation of the examination results data.

Conclusion

The Deakin University School of Medicine is a newly created medical school, with no prior experience delivering training in a traditional model. The inaugural cohort of students graduated at the end of 2011, providing the first opportunity to evaluate the effectiveness of the chosen teaching methods across the entire course. Previous studies of adopted innovative educational methods, conducted at other institutions, have indicated that a medical school can implement the programs described in these studies, without disadvantaging the participating students. These studies have been conducted in medical schools that had years of experience delivering a traditional medical course prior to introducing the new methods. Given this context, these results cannot be relied upon as conclusive evidence to support the effectiveness of the Deakin School of Medicine's decision to implement such a completely innovative program in a newly established medical school.

The question for the Deakin University School of Medicine is whether the school can confidently undertake its' multiple innovative educational programs, commencing in

the school's inaugural year, without a detrimental effect on students within individual programs. Collectively, the previous studies appear to provide enough evidence to try the adopted Deakin approach without doing the students harm; however, this needs to be confirmed.

The great majority of these prior studies have looked at introducing a new, or modified, delivery of medical education into a school with established credible evidence of years of a successful traditional tertiary centre based approach. These studies have compared a new approach with what was already established practice within their schools. The Deakin University course differs in that it has introduced the modern clinical education methods of dispersed, small groups of students, in rural settings with its first cohort of students. Thus it is critically important, both to inform the development of fledgling medical schools around the world and for the Deakin University School of Medicine's internal quality improvement.

The results of the preceding literature review indicate the need to use both educational outcome, via examination results, and the DREEM assessment of educational environment, to gain a meaningful understanding of the appropriateness of the Deakin University School of Medicine's approach.

Chapter 3. Research design

Research approach

The preceding description of the literature review indicates the need to assess the educational outcomes of the implementation of the newly created Deakin University School of Medicine course.

According to Crotty (1998) there are four elements to be considered when designing a research project:

Epistemology, being the theory of knowledge embedded in the theoretical perspective and thereby in the methodology.

Theoretical perspective, the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria.

Methodology, which is the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and the use of methods to the desired outcomes.

Methods, the techniques or procedures used to gather and analyze data related to some research question or hypothesis.

Medical research has long adopted the traditional scientific ontological approach of realism- a "notion asserting that realities exist outside the mind" (Crotty, 1998,p.10). That is, there exists a real state of existence, independent of observation, which we attempt to discover, and understand, through the scientific approach of postulating a theory; followed by experimentation to support or deny the hypothesis.

This view leads to the objectivist epistemology that knowledge of that independent state awaits discovery by an objective observer. The historic scientific approach held that an individual scientist could adopt a completely impartial stance to allow such an objective appraisal, the positivist perspective. Moving out of the twentieth century the post-positivist theoretical perspective has arisen, in which it is recognised that no individual can eradicate the influence of their beliefs from their observation of new phenomena; rather, objectivity is approximated by multiple studies of the same event through different approaches and/or different observers. In a post-positivist approach the observer's perspective, and beliefs, are seen to be as important as the observations themselves.

When it comes to medical student examination performance, students achieve a pass or a fail, they obtain a distinction or they do not, they are suitably skilled or they are not. The community want to know someone who holds a medical degree has the skills and knowledge to be worthy of it. Examination scores will directly impact on a student's opportunities for post-graduate training, and subsequent career path. Considering the high stakes nature of medical student assessment, for students and society, the primary researcher considered a positivist theoretical perspective is the most appropriate approach to employ, with its objective validity and reliability of results.

Thus, this study was designed to add to the existing body of knowledge regarding the innovative educational approaches employed by the School of Medicine, through examining their application in the new context of applying multiple such methods from

inception of an entirely new medical school. Furthermore, this study will inform the Deakin University School of Medicine of the success, or not, of its multiple approaches to providing clinical education, by analysing both the objective final assessment scores and the students assessment of their educational experience, via the DREEM questionnaire.

To achieve these twin goals the method of statistical analysis has been adopted to interrogate the summative assessment data; whilst a validated questionnaire, the Dundee Ready Educational Environment Measure (Roff, 2005), was posted to the participants to assess their educational environment.

Aim

The aim of this study was to assess the educational outcomes of the multiple approaches to medical education that the medical school adopted from its inception.

The research question was:
Are the educational outcomes, as measured by final year assessment result, for Deakin University medical students different according to the clinical school in which the students undertake their clinical studies in years three and four of the medical course?

A cohort study, including consecutive years of final year medical students at the Deakin University School of Medicine, was designed to test the null hypothesis that final year medical student's assessment performance is not adversely influenced by

their experience within the divergent environments of the five clinical schools comprising the Deakin University School of Medicine clinical education sites.

A student's experience is known to influence their academic performance. However, the question here is whether the various student experiences of the different clinical schools has adversely affected their results in relation to the more traditional site of the Geelong Clinical School, which hosts large student groups rotating through sub-specialty units within a tertiary hospital. The DREEM questionnaire was employed to quantify the students' educational experiences.

This question needed to be addressed to assess that appropriately trained graduates were being produced from each of the clinical sites within the medical school. It is important to ensure future patient safety, with regard to graduates of this school, and inform the quality assurance of the Deakin University School of Medicine. Furthermore, the results of this study will help assist the planning of educational delivery within future new medical schools.

Study Design

The study design was a retrospective cohort study. The outcome measure, the 'independent variable' in data analysis, was a single, integrated end of year objective assessment result, comprising a multiple choice question (MCQ) examination plus an objective structured clinical examination (OSCE). An intermediate outcome measure was a self-reported assessment of the student's educational experience, measured using the DREEM questionnaire. This was used as an outcome measure in its own

right, because students' experience may have been associated with the clinical school they attended, and as an intermediate variable in determining the students' final year assessment result.

The students also undergo intra-rotational assessments during each of the rotations they undertake across the clinical training years. These include mini clinical examinations (mini-CEX), clinical case presentations, preparations of Wiki pages, reflective journals, group presentations, and log book records of clinical experience. As the focus of this project requires comparison of assessment performance between clinical sites, the MCQ and OSCE assessments alone were chosen for inclusion in this study due to their objective nature and central preparation. This mitigates the possible confounder of local variability in assessment standards between sites.

Pooled data from two consecutive year cohorts have been used. As this research is comparing assessment results between sites, rather than between years, any variation in assessment difficulty between the years is irrelevant. The students in a particular year cohort were all assessed by identical MCQ & OSCE tasks. The comparison is in regards to how the members of each cohort performed relative to each other. Pooling the two cohorts' data increases the number of participants in, and therefore the power of, the study. Ultimately, the mean of the two cohorts' assessments are compared between sites, not between the year cohorts.

Data collected for this study included objective assessment results (MCQ and OSCE) from the baseline end of year 2, prior to dividing into clinical site groups, and both

years 3 and 4, post this division; demographic information collected routinely by the school; and a self-reported student educational experience.

The students' experience of their clinical school educational environment was measured by a survey of students using the Dundee Ready Education Environment Measure (DREEM) questionnaire. This is a validated quantitative survey instrument consisting of 50 items that assess five components: perceptions of learning; perceptions of teachers; academic self-perception; perceptions of atmosphere; and social self-perceptions (Roff et al., 1997).. The DREEM survey was conducted once, for each year cohort, following completion of the students' final, year 4, assessment period. This timing was chosen to eliminate possible confounding of responses due to any potential concern amongst the students that their responses might subsequently affect their course assessments. Unfortunately, this timing led to an unforeseen difficulty, rendering analysis of the Rural 3 student responses to the DREEM survey unreliable. The Rural 3 students DREEM data have been omitted from the analysis in this study, as the Rural 3 experience wasn't assessed immediately following the students year three Rural 3 experience; thus, it is not clear whether the IMMERSe students responses to the survey were provided with regard to their year 4 clinical school experience, their year 3 experience, or a combination of both.

At the request of the joint heads of clinical schools, four further questions were added to the end of the DREEM questionnaire, to gain information regarding some specific issues, which were considered could potentially interfere with student performance.

The primary exposure variable, or dependent variable in data analysis, was the clinical school attended by each student. Other exposure variables included in analysis, because they were potential sources of bias of both outcome measures, were the students' demographic characteristics:

- age at commencement of clinical training;
- gender;
- remoteness of residence prior to commencing the medical degree, according to the previously described RRMA classifaction; and
- clinical experience prior to commencing the course.

The students' GAMSAT score was also considered as a potential confounding variable. Two cohorts of students were included in this study to increase the number of participants within the study; thereby, increasing the power of the study.

Participants

The study population was students who undertook the final (fourth) year of the Deakin University medical degree in 2011 or 2012. There were no exclusion criteria, all final year students were invited to participate. There were 236 eligible students, 109 students in 2011, and 127 students in 2012.

There were no international students in the initial cohort, and one in the second. Within the study population there were 52 rural bonded students and 55.56% of the students were female. Two students failed year 3, one student intermitted year 3, and three students intermitted year 4.

The gender balance was close to an equal split at Metro 2, Rural 1, Rural 2 & rural 3 clinical schools; whilst it was closer to one third male, two thirds female, at Metro 1. (Figure 4.1, Appendix 2). The median age at commencement of clinical training was 26.1 years (range 23 – 53). The age distribution is shown in Figure 4.2 (Appendix 2).

The ideal objectivist approach would have involved the subjects being randomly assigned to the various clinical schools. However, as this approach was acceptable to neither the University, nor the students themselves, the participants in this study self-selected the clinical school they attended, to the extent possible within the limits of available places at each site. Students were assigned on the basis of a descending ordered list of their preferred clinical site. This pragmatic approach is required in student centred medical education, where student choice cannot be ignored when it comes to issues such as, place of residence, need for social supports, and potential family relocation. Thus, a quasi-experimental methodology was adopted.

Study Power

Two cohorts of students were included to boost the power of the study by increasing the numbers of students included at each of the sites. Prior to the study commencing power estimates were calculated to detect a difference in mean scores of plus, or minus, 5 points and plus, or minus, 7 points, a difference of 5% and 8% respectively, between Geelong and each of the other four clinical schools, for two study endpoints: after one year and following two years. Power estimates were based on the mean final

examination score of 91 (out of 150) and standard deviation of 9.5 at the 2011 final examinations, with alpha level of 0.05 for a two-sided test.

When comparing the Metro 1 clinical school, which had approximately half the cohort, with the two medium-size schools (Rural 1 and 2), the study was determined to have 77-82% power to detect an eight percent difference in mean score after one year, and 85% power to detect a five percent difference after two years.

The study had insufficient power to compare Metro 1 with the two smaller schools (Metro 2 and Rural 3) after the first year. After two years, the study was determined to have 66-70% power to detect a five percent difference and 91-94% power to detect an eight percent difference.

Table 3.1 Study power estimates

	Metro 1	Rural 2	Rural 1	Metro 2	Rural 3
2011 graduates only					
Number of students	63	20	17	9	11
Power, 5 point diff (%)[a]	na	54	47	32	36
Power, 7 point diff (%)[b]	na	82	77	54	62
2011 & 2012 graduates					
Sample size	135	42	42	25	27
Power, 5 point diff (%)[a]	na	85	85	66	70
Power, 7 point diff (%)[b]	na	99	99	91	94

a. Power to detect a difference of +/-5 points between the average student score of 91 points at Metro 1 clinical school and the average student score at each of the other clinical schools.

b. Power to detect a difference of +/-7 points between the average student score of 91 points at Metro 1 clinical school and the average student score at each of the other clinical schools

na. Not applicable.

Data collection

Demographic data and final year assessment results for each student were provided by the School of Medicine from the student administration information system. The DREEM questionnaire was posted to students by the School of Medicine, with a letter of invitation to participate, and a plain language statement explaining the process and the reason for the research. Completed questionnaires were returned to Dr. Brendan Condon. Data entry, and assignation of an unique study number was performed by Mrs. Kelli Vertigan, with the DREEM results being matched to demographic and assessment results prior to analysis.

The questionnaire was administered to help identify the effect of educational experience on assessment outcomes. This was done following the end-of course assessments to prevent any possible bias of questionnaire responses due to any misconception that student assessment might be influenced by opinions expressed.

Method of Analysis

The primary outcome measure was each student's objective assessment score; a single numeric score, which is the combination of the equally weighted, MCQ and OSCE

end of year assessments. The primary explanatory variable of interest is the clinical school at which each student did their clinical training in years 3 and 4.

The DREEM survey score, and the five component scores, were analysed as intermediate outcome measures. That is, the association between DREEM scores and clinical site was analysed, and DREEM scores were included as potential explanatory variables in analysis of the primary outcome measure.

Potential confounding variables considered in the analysis include each student's: age at commencing clinical training, gender, rural background (RRMA category at admission), primary degree, previous experience, GAMSAT score, second year assessment result, commencement/completion year and DREEM scores.

Analysis included:

- Descriptive analysis of the study cohort: demographic characteristics, other potential confounders, outcome measures.
- Univariate analysis of associations between the explanatory/confounding variables and outcome measures
- Multivariate analysis of associations between explanatory/confounding variables (including DREEM scores) and the main outcome variable (assessment score)

The strength of associations in univariate analyses were assessed using standard statistical tests (Student's T-Test for mean scores; chi-squared test for proportions) and

calculation of 95% confidence intervals. Multivariate analyses used linear regression for analysis of final assessment scores as a continuous variable.

Age at commencing clinical training and gender were included as potential confounding variables in all regression models. Variables of a-priori interest (rural background, clinical school, bonded) were included in the final model whether or not they were associated with the outcome. Year 2 examination result was included in the final model because it was strongly associated with examination results for subsequent years and improved the model fit considerably. GAMSAT score was found to be not associated with examination results and was not included in the final models. A separate analysis with the DREEM score as the outcome was performed for the subset of 131 students who complete the DREEM questionnaire.

For the purpose of comparing metropolitan clinical training sites to rural clinical training sites, RRMA classifications metropolitan 1 & 2 were combined, as were rural 1,2 & 3.

The study was approved by the Deakin University Human Ethics Advisory Group – Faculty of Health, Medicine, Nursing and Behavioural Sciences (Number HEAG-H 110 _11). Data access was approved by the data custodian, Dr. David Kramer. Data analysis was performed using Stata V 10 (StataCorp).

Chapter 4. Results

Introduction

In order to establish the academic outcomes of the varied approaches to clinical education adopted within the Deakin University School of Medicine, the end of year assessment results for years two, three, and four, have been collected. Also, the students' clinical educational environment has been surveyed via the Dundee Ready Educational Environment Measure (DREEM).

Post hoc power

The power to detect 1, 2 and 3 unit difference in year 4 exam scores has been calculated, comparing the reference (Metro 1) group with a comparison group size of 30 (the number of students in the Rural 2 group, which was similar in size to the Rural 1 group).

For sample size: reference group 122, comparison group 30

Mean score group1: 68.4 units

Standard deviation: 7.1 units

Alpha level: 0.05

To detect difference of 1 unit (i.e. mean score group 2 of 69.4): power 10.2%

To detect difference of 2 unit (i.e. mean score group 2 of 70.4): power 28.2%

To detect difference of 3 unit (i.e. mean score group 2 of 71.4): power 54.5%

An on-line power calculator, http://clincalc.com/Stats/Power.aspx, was used to perform the power calculations.

Within this study, the dependent variable being analysed was the end of year assessment score, with the independent variable being the clinical school attended. Potential confounding factors that were considered include: gender, age, previous clinical experience, rural background, rural bonded status, international student status, and educational environment.

The male group outperformed the female group in the GAMSAT test, prior to admission to the course; as can be seen in figure 4.3 (Appendix 2). The disparity in scores was 1.9%, which was shown to be significant in the multivariate analysis which follows.

The great majority of students in the first two cohorts of the Deakin medical school came from a metropolitan background (figure 4.5, Appendix 2)

Approximately twenty percent of the students at each clinical school were rurally bonded; that is, they are required to work in a rural 'area of medical workforce need' once they have completed their vocational training (figure 4.6, Appendix 2). Rural 1 had the greatest percentage, at 24.32%.

DREEM Results

Forty four percent of the Metro 1 students returned their DREEM survey, with sixty one percent of the Rural 1 and fifty four percent of the Metro 2 students returning theirs, whilst seventy percent of the Rural 3 and eighty seven percent of the Rural 2 students responded (figure 4.7, Appendix 2).

The total mean score for the combined responses from all clinical sites within the Deakin School of Medicine was 140.9, with no significant gender difference, as per table 4.1.

Table 4.1. DREEM total scores (visual presentation Fig. 4.8, Appendix 2)

Clinical school	Gender		
	Male	Female	Total
Metro 1	20	35	55
	140.6	138.5	139.3
Rural 1	15	7	22
	133.1	138.4	134.8
Metro 2	4	9	13
	127.5	131.4	130.2
Rural 2	10	16	26
	153.2	156.0	154.9
Total	49	67	116
	139.8	141.7	140.9

Total DREEM Score	
Score	Rating
0-50	Very poor
51-100	Plenty of problems
101-150	More positive than negative
151-200	Excellent

Table 4.2. DREEM component scores (visual presentation Fig. 4.9, Appendix 2)

Clinical school		Gender		
		Male	**Female**	**Total**
Metro 1	Perception of Learning	34.6	34.2	34.4
	Perception of course organizers	31.1	30.2	30.5
	Academic self-perception	22.1	21.0	21.4
	Perception of atmosphere	34.3	36.5	35.7
	Social self-perceptions	18.7	19.5	19.2
Rural 1	Perception of Learning	32.0	34.3	32.7
	Perception of course organizers	29.6	28.9	29.4
	Academic self-perception	20.7	21.1	20.9
	Perception of atmosphere	33.5	34.0	33.6
	Social self-perceptions	17.9	20.1	18.6
Metro 1	Perception of Learning	28.3	32.3	31.3
	Perception of course organizers	28.0	30.0	29.5
	Academic self-perception	20.0	21.1	20.8
	Perception of atmosphere	32.0	32.9	32.6
	Social self-perceptions	20.3	17.9	18.7
Rural 2	Perception of Learning	36.4	37.7	37.2
	Perception of course organizers	34.2	34.3	34.2
	Academic self-perception	22.7	23.2	23.0
	Perception of atmosphere	37.8	38.6	38.3
	Social self-perceptions	22.0	22.4	22.2
Total	Perception of Learning	33.8	34.8	34.3
	Perception of course organizers	31.1	31.0	31.0
	Academic self-perception	21.6	21.6	21.6
	Perception of atmosphere	34.4	36.3	35.5
	Social self-perceptions	19.3	20.1	19.8

With regard to 'perception of learning', all sites were rated in the "more positive perception" range, except for Rural 2, which rated within the higher "teaching highly thought of" range;

Perception of learning	
Score	Rating
0-12	Very Poor
13-24	Teaching is viewed negatively
25-36	A more positive perception
37-48	Teaching highly thought of

‘Perception of course organizers’, was rated at all sites, except Rural 2, within the “moving in the right direction” range. Rural 2 rated within the higher “model course organisers” range;

Perception of Course organisers	
Score	Rating
0-11	Abysmal
12-22	In need of some retraining
23-33	Moving in the right direction
34-44	Model course organisers

For ‘academic self-perception’, all sites were rated as “feeling more on the positive side”;

Academic Self Perceptions	
Score	Rating
0-8	Feelings of total failure
9-16	Many negative aspects
17-24	Feeling more on the positive side
25-32	Confident

When assessing ‘perception of atmosphere’, Rural 2 rated within the higher “a good feeling overall” range, whilst the remaining sites rated within “a more positive attitude”; and

Perception of Atmosphere	
Score	Rating
0-12	A terrible environment
13-24	There are many issues which need changing
25-36	A more positive attitude
37-48	A good feeling overall

‘Social self-perception’, was again rated at Rural 2 within the higher “very good socially” range, whilst the rest of the sites rated within the “not too bad” range.

Social Self Perceptions	
Score	Rating
0-7	Miserable
8-14	Not a nice place
15-21	Not too bad
22-28	Very good socially

In summary, all sites rated within the top two scoring ranges for each component of the DREEM questionnaire. Rural 2 scored the highest in every component, and was the only site to register within the top scoring range- doing so for all components, other than academic self-perception.

Academic performance results

Comparisons were made between the tertiary referral centre, as the reference site, and all other clinical training sites. The end of year assessment scores are displayed in tables 4.10- 4.13, below. As the following univariate analyses show (table 4.6), the year 2 mean assessment results are all quite similar, with no significant difference between the mean scores of the groups of students who subsequently undertook their clinical training at the respective clinical school sites. Greater variation between the mean scores achieved at the various clinical school sites appears at the end of years 3 and 4.

Table 4.3. Year 2 Mean exam score, by clinical school & gender and year of course

Clinical School	Year 2 results			
		N	Mean	SD
Metro 1	male	49	70.7	4.5
	female	75	71.8	4.9
Rural 1	male	20	71.3	3.5
	female	15	71.6	7.7
Metro 2	male	11	70.1	4.5
	female	13	70.5	7
Rural 2	male	13	71	6.5
	female	16	73.6	4.9
Rural 3	male	14	70.2	4
	female	13	72.1	5

Table 4.4. Year 3 Mean exam score, by clinical school & gender and year of course

Clinical School	Year 3 results			
		N	Mean	SD
Metro 1	male	50	66.9	5.5
	female	73	68.9	5.3
Rural 1	male	20	68.5	5.4
	female	16	69.6	7.1
Metro 2	male	11	65.8	5.2
	female	12	66.7	6.5
Rural 2	male	13	71.5	4.7
	female	17	73.1	5.3
Rural 3	male	14	66	6.8
	female	13	66.3	4.7

Table 4.5. Year 4 Mean exam score, by clinical school & gender and year of course

Clinical School	Year 3 results			
		N	Mean	SD
Metro 1	male female	50 72	68.4 68.4	7.8 6.7
Rural 1	male female	20 16	70.1 71.9	8.6 8.6
Metro 2	male female	11 11	68.5 68.6	8.7 5.2
Rural 2	male female	13 17	73.2 73.8	7.9 7.2
Rural 3	male female	14 12	70.8 70.2	6.5 4.6

Univariate analyses results, regarding the academic performance scores, for years 2, 3, and 4, of the course, are presented below. They reveal significant differences in the high stakes year 3 assessment results, according to: gender, previous clinical experience, Rural 3 participation, rural clinical school site, and Rural 2 site. In the year 4 analyses, the variables with significant results were reduced to: rural clinical school site, small clinical school site, and the Rural 2 site.

Statistical analysis of data

Univariate analysis

As can be seen in table 4.6, T test analysis of mean assessment result between each of the smaller clinical sites and the reference site, Metro 1, demonstrates:

- no significant difference between the groups that would subsequently attend the various clinical training sites in the year 2 assessment, the Rural 2 site provided a significantly higher mean score in year 3. T=3.77, p=0.00, and
- in year 4 , the Rural 2 site again provided the only significant difference, which was higher, t=3.44, p=0.00.

Table 4.6. T test analysis of mean assessment result between each of the smaller clinical sites and the reference site, Metro 1, by year of course

Year of course Clinical school	Number of students	Mean score	95% CI	t test*	p-value
Year two					
Metro 1	135	71.48	70-67-72.30	-	-
Rural 1	39	71.35	69.60-73.11	0.15	0.88
Metro 2	24	70.30	67.82-72.78	1.08	0.28
Rural 2	41	71.57	69.85-73.30	0.10	0.92
Year three					
Metro 1	134	67.79	66.86-68.71	-	-
Rural 1	40	68.36	66.22-70.50	0.55	0.58
Metro 2	23	66.27	63.76-68.78	1.23	0.22
Rural 2	42	71.36	69.73-72.99	3.77	0.0002
Year four					
Metro 1	132	68.54	67.34-69.75	-	-
Rural 1	40	70.69	68.05-73.12	1.63	0.11
Metro 2	22	68.59	65.49-71.69	0.03	0.98
Rural 2	42	72.83	70.57-75.09	3.44	0.0007

Reliance on overall mean assessment scores runs the risk of a site with some exceptionally performing students masking a site with an excessive number of poorly performing students, creating a deceptively high mean. To address this possibility univariate analysis, of the mean assessment results, of the bottom 20% of year 4 students, is presented in table 4.7, below. It similarly demonstrates a significantly

higher result at the Rural 2 site, t=2.85, p=0.008, as the only result that significantly varies from the reference site.

Table 4.7. Students in the bottom 20% of year 4 results at each school, Rural 1, Metro 2 and Rural 2, compared with Metro 1 clinical school.

Clinical school	Number of students	Mean score	95% CI	t test*	p-value
Metro 1	27	58.48	56.67-60.29	-	-
Rural 1	8	59.98	57.71-62.25	0.88	0.39
Metro 2	5	58.80	52.67-63.93	0.14	0.89
Rural 2	9	62.98	61.48-64.49	2.85	0.008
* comparing each school with Metro 1.					

Further univariate (t test) analysis was undertaken between various comparison groups.

T test analysis revealed:

- No significant difference in mean assessment score between males & females in years 2, or 4, of the course (table 4.8). The gender difference in year 3 assessment was significant, t= 1.99, p= 0.05; however, the difference in mean score, upon which this analysis was based, is only 1.5%. This is not likely to greatly influence future career plans;
- No significant difference in mean assessment score between students with a rural background & those without, in years 2, 3, or 4, of the course (table 4.9);
- No significant difference in mean assessment score between rural bonded students & those not so bonded, in years 3, or 4, of the course (table 4.10);

Table 4.8. T test analysis of mean assessment result between genders, by year of course

Year	Gender	No.of students	Mean	95% CI	T test	p-value
2	Male	107	70.70	69.84-71.57		
	Female	132	71.89	70.95-72.84	1.80	0.07
3	Male	108	67.55	66.45-68.64		
	Female	131	69.04	68.03-70.04	1.99	0.05
4	Male	108	69.60	68.09-71.11		
	Female	128	69.74	68.52-70.96	0.15	0.89

Table 4.9. T test analysis of mean assessment result by rural background, by year of course

Year	Rural b'ground	No.of students	Mean	95% CI	T test	p-value
2	No	173	71.21	70.41		
	Yes	66	71.76	70.68	0.74	0.46
3	No	173	68.40	67.57-69.22		
	Yes	66	68.28	66.65-69.91	0.14	0.89
4	No	171	69.28	68.13-70.42		
	Yes	65	70.72	69.04-70.62	1.34	0.18

Table 4.10. T test analysis of mean assessment result by rural bonded students, by year of course

Year	Rural bonded	No.of students	Mean	95% CI	T test	p-value
2	No	187	71.74	71.00-72.47		
	Yes	52	70.01	68.62-71.41	2.17	0.03
3	No	187	68.69	67.86-69.52		
	Yes	52	67.21	65.54-68.87	1.63	0.10
4	No	184	70.05	68.97-71.13		
	Yes	52	68.36	66.34-70.37	1.46	0.15

There was a significant difference in the year 3 assessment scores between those students participating in the Rural 3 program and the non-Rural 3 students, t=2.11, p= 0.04, but not so for the year 2assessments (table 4.11). The non-Rural 3 students mean

score was 2.5% higher than that of the Rural 3 students, in year 3. However, there was no significant difference between these two groups in the ultimate year 4 assessment.

Table 4.11. T test analysis of mean assessment result by Rural 3 participation, by year of course

Year	Rural 3	No.of students	Mean	95% CI	T test	p-value
2	No	212	71.39	70.69-72.09		
	Yes	27	71.15	69.36-72.93	0.23	0.82
3	No	212	68.65	67.86-69.43		
	Yes	27	66.15	63.88-68.43	2.11	0.04
4	No	210	69.57	68.53-70.60		
	Yes	26	70.54	68.29-72.79	0.63	0.53

There was no significant difference in assessment score between students with previous clinical experience, and those without, in year 2. In table 4.12, it can be seen that the year 3 mean assessment score of those students with previous clinical experience was significantly higher than those with no previous clinical experience, t= -3.06, p=0.00.

Table 4.12. T test analysis of mean assessment result by previous clinical experience, by year of course

Year	Clin. experience	No. of students	Mean	95% CI	T test	p-value
2	No	190	71.07	70.36-71.78		
	Yes	48	72.39	70.79-73.99	1.62	0.11
3	No	189	67.77	66.95-68.60		
	Yes	48	70.60	68.96-72.25	3.06	0.00
4	No	186	69.48	68.42-70.54		
	Yes	48	70.59	68.33-72.85	0.93	0.36

The students attending rural clinical schools, Rural 1 and Rural 2, significantly outperformed those attending the metropolitan clinical schools, Metro 1 and Metro 2, with regard to year 4 assessment mean scores, t= 3.26, p= 0.00 (table 4.13).

Table 4.13. T test analysis of mean assessment result by rural clinical school, by year of course

Year	Rural school	No.of students	Mean	95% CI	T test	p-value
2	Metro	159	71.31	70.53-72.08		
	Rural	80	71.46	70.26-72.67	0.22	0.82
3	Metro	157	67.56	66.70-68.43		
	Rural	82	69.90	68.55-71.25	3.00	0.00
4	Metro	154	68.55	67.44-69.66		
	Rural	82	71.79	70.08-73.49	3.26	0.00

Also, the mean assessment year 4 scores of students who attended small clinical schools, Rural 1, Metro 2, and Rural 2, significantly outscored those at the large clinical school, Metro 1, t= 2.68, Pr|T|>|t|= 0.01 (table 4.14).

Table 4.14. T test analysis of mean assessment result by small clinical school, by year of course

Year	Small school	No.of students	Mean	95% CI	T test	p-value
2	Metro 1	135	71.49	70.67-72.30		
	The rest	104	71.20	70.13-72.27	0.44	0.66
3	Metro 1	134	67.79	66.86-68.71		
	The rest	105	69.10	67.90-70.31	1.75	0.08
4	Metro 1	132	68.54	67.34-69.75		
	The rest	104	71.11	69.61-72.61	2.68	0.01

In line with the above, the mean assessment score attained at Rural 2 outperformed the rest of the school combined, t= 1.41, p= 0.00 (table 4.15).

Table 4.15. T test analysis of mean assessment result by Rural 2 attendance, by year of course

Year	Rural 2	No.of students	Mean	95% CI	T test	p-value
2	No	198	71.32	70.61-72.02		
	Yes	41	71.57	69.85-73.30	0.29	0.77
3	No	197	67.73	66.92-68.53		
	Yes	42	71.36	69.73-72.99	3.79	0.00
4	No	194	68.99	67.96-70.02		
	Yes	42	72.83	70.57-75.09	1.41	0.00

Multivariate analysis

Linear regression analysis was undertaken, using several outcome measures, including GAMSAT score, DREEM total score, and Year 4 exam results. The distribution of outcome variables (years 2, 3 and 4 examination results and DREEM score) was tested using p-p plots (Figures 4.1-4.4); the distribution of each variable was approximately normal.

Figure 4.1. P-P plot for year 2 assessment results

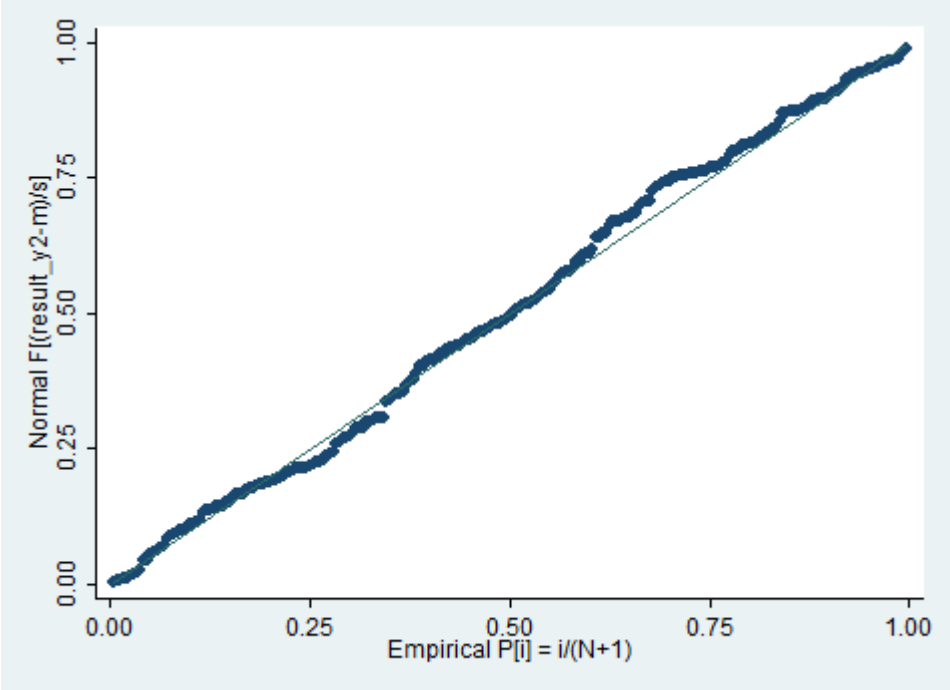


Figure 4.2. P-P plot for year 3 assessment results

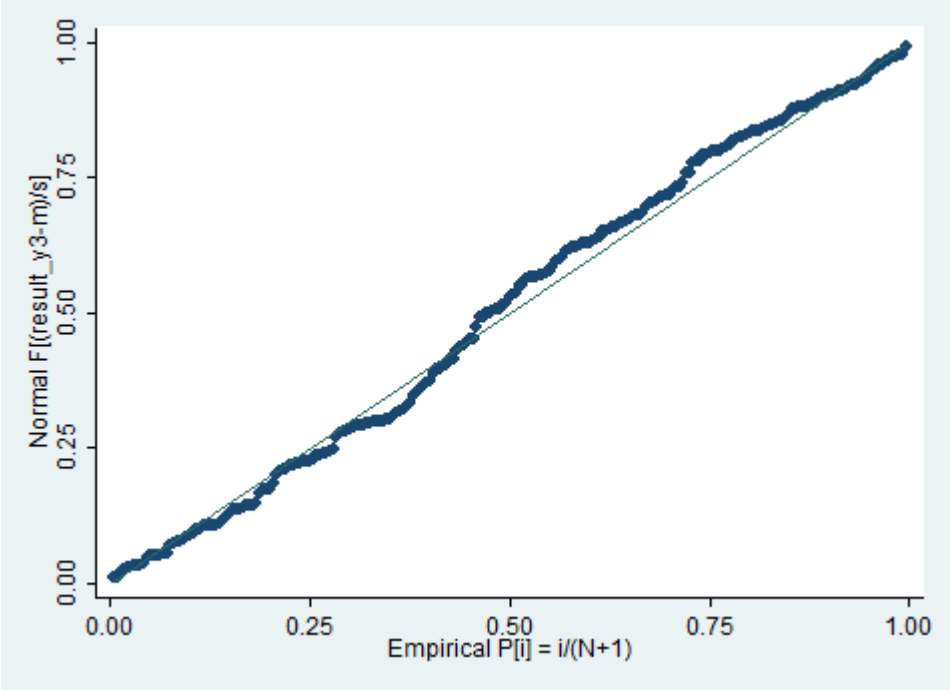


Figure 4.3. P-P plot for year 4 assessment results

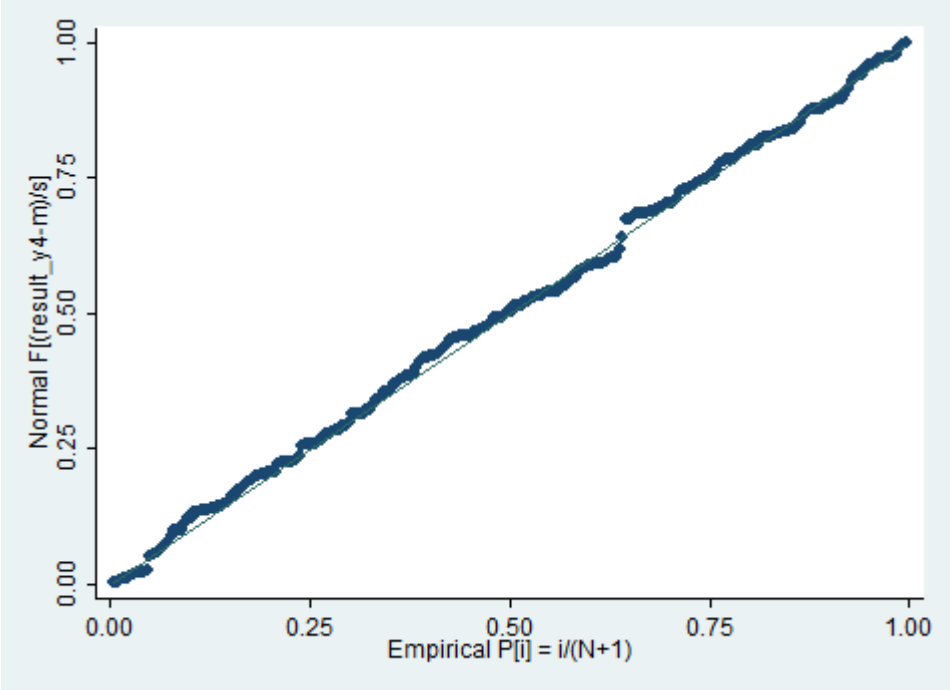
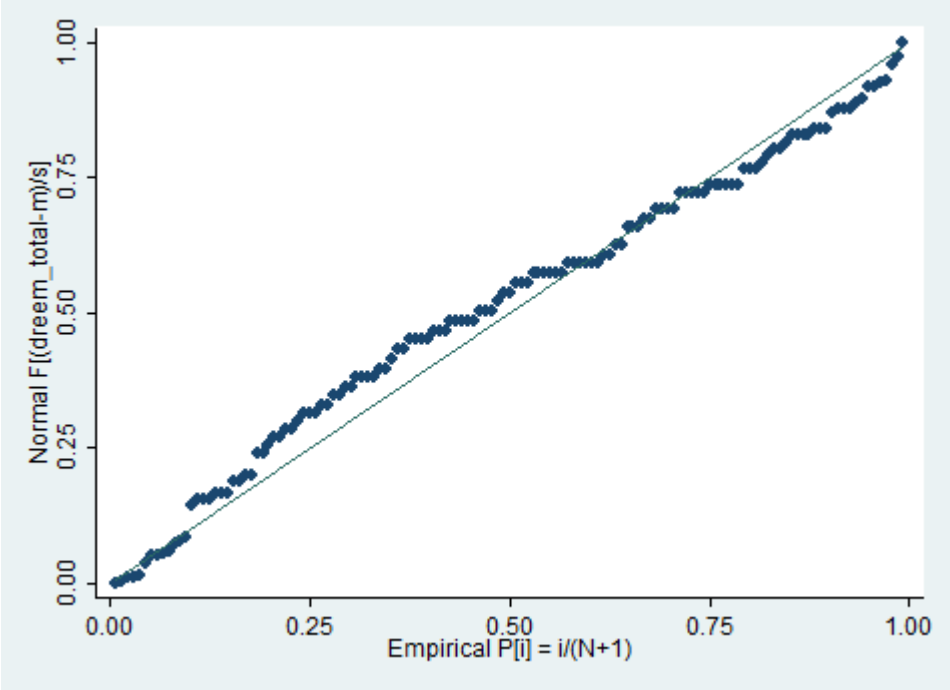


Figure 4.4. P-P plot for DREEM Total questionnaire results



Multivariate analysis reveals males outperformed females in the GAMSAT examination by a coefficient of 1.69 ($p < 0.01$), which reflects a mean score difference of 1.9%. The students who went on to undertake their clinical training at Metro 2 had a significantly higher GAMSAT score than the comparison group, with a coefficient of 2.73 ($p<0.05$); that is a mean score 2.9% higher. Rural bonded students underperformed, in comparison to Metro 1 students, by a coefficient of 1.93 ($p<0.01$).

In year 3 assessment (table 4.16), the female student group produced a significantly higher mean score than the males, with a mean score difference of 1.5%, giving a coefficient of 1.94 ($p=0.01$), however, this was no longer evident in year 4 assessment. Similarly, a higher GAMSAT score produced a significantly higher year 3 result, coefficient 0.19 ($p=0.02$),indicating 0.192% higher year 3 assessment score for every 1% higher GAMSAT score; but no significant benefit in year 4.

Table 4.16. Year 3 assessment results , N=225, R-squared= 0.15, R=0.39

result_y3	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	1.94	.75	2.57	0.01	.45	3.42
Rural 1	1.80	1.09	1.66	0.10	-.34	3.95
Metro 2	-1.25	1.36	-0.92	0.36	-3.93	1.44
Rural 2	4.75	1.16	4.10	0.00	2.47	7.03
Rural 3	-1.87	1.17	-1.60	0.11	-4.16	.43
Age starting Y3	-.03	.09	-0.29	0.77	-.20	.15
Rural Bonded	-1.13	.89	-1.26	0.21	-2.88	.63
Rural_b'ground	-.18	.83	-0.22	0.83	-1.82	1.45
GAMSAT	.19	.082	2.35	0.02	.03	.35

Rural 2 students achieved a significantly higher mean assessment result in both year 3, coefficient 4.75 (p=0.00), in table 4.16, with a 4.3% higher mean, and year 4, table 4.17, coefficient 5.11 (p=0.00), a 5.1% higher mean score.

Table 4.17. Year 4 assessment results N=222, R-squared= 0.36, R= 0.60

result_y4	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	-1.23	.86	-1.43	0.15	-2.93	.46
Rural 1	2.15	1.21	1.78	0.08	-.23	4.53
Metro 2	.66	1.54	0.43	0.67	-2.38	3.70
Rural 2	5.11	1.28	3.98	0.00	2.58	7.64
Rural 3	2.09	1.31	1.60	0.11	-.49	4.66
Age commenced Yr3	-.16	.10	-1.66	0.10	-.36	.03
Rural bonded	-.27	1.00	-0.27	0.79	-2.24	1.70
Rural_student	.94	.92	1.02	0.31	-.87	2.76
GAMSAT	-.02	.09	-0.22	0.83	-.20	.16
Result Yr2	.82	.09	9.16	0.00	.64	1.00

In the regression analysis of Year 4 results (table 4.17), Year 2 results were strongly associated with Year 4 results. The R^2 value with Year 2 results in the model is 0.36 (c/w 0.11 for the model without Year 2 results). Without Year 2 results in the model GAMSAT was weakly associated with Year 4 results but the p-value was 0.2; with Year 2 results in the model GAMSAT was not associated with Year 4 result at all. So a model without GAMSAT has been included.

When the GAMSAT data is excluded from the analysis it can be seen, in Table 4.18, that, in comparison with Metro 1, Rural 1 students mean year 4 assessment results were significantly higher, with a coefficient of 2.23 (p=0.05); this reflects a 2.5% higher mean score.

Table 4.18. Year 4 assessment results, excluding GAMSAT R-squared= 0.39, R= 0.63, N=233

result_y4	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Gender	-1.01	.80	-1.26	0.21	-2.58	.57
Rural 1	2.23	1.15	1.94	0.05	-.04	4.50
Metro 2	.41	1.37	0.30	0.76	-2.30	3.12
Rural 2	4.77	1.23	3.88	0.00	2.35	7.20
Rural 3	2.08	1.29	1.61	0.11	-.46	4.61
Age commenced Yr3	-.19	.09	-2.06	0.04	-.37	-.01
Rural bonded	-.34	.94	-0.36	0.72	-2.20	1.52
Rural_student	1.05	.89	1.18	0.24	-.71	2.82
Result Yr2	.82	.08	10.30	0.00	.66	.98

Including the DREEM data, as in table 4.19 below, leaves Rural 2 as the only clinical school with a significant result when looking at the year 4 assessment results, coefficient 4.02 (p= 0.00).

Table 4.19. Year 4 assessment results (DREEM included) N=131, R-squared= 0.41, R= 0.64

result_y4	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Gender	.28	1.07	0.26	0.80	-1.85	2.40
Rural 1	.06	1.51	0.04	0.97	-2.93	3.05
Metro 2	-2.04	1.82	-1.12	0.27	-5.63	1.57
Rural 2	4.02	1.43	2.80	0.00	1.18	6.85
Rural 3	1.56	1.52	1.03	0.31	-1.46	4.58
Age commenced Yr3	-.151	.11	-1.40	0.17	-.37	.06
Rural bonded	-.50	1.30	-0.39	0.70	-3.07	2.06
Rural_student	1.90	1.12	1.70	0.09	-.31	4.12
DREEM_total	-.01	.02	-0.57	0.57	-.06	.03
GAMSAT	.04	.12	0.36	0.72	-.19	.27
Result Yr2	.77	.10	7.43	0.00	.57	.98

In the interests of parsimony, Likelihood Ratios were calculated for the multivariate analyses of the year 4 assessment results, after sequentially removing one variable from the model that did not appear to produce any significant effect upon the model.

This process indicated that inclusion of gender, Rural 3 status, rural bonded status, and age at commencement of clinical years did not significantly affect the relationship between the assessment results from the different clinical school sites. On the other hand, rural clinical school status proved to have a significant influence. Therefore, uncomplicated analysis of assessment results between the clinical school sites can be relied upon to indicate significant differences between the sites.

The only site with significantly different DREEM scores relative to the reference site, Metro 1, was Rural 2. The mean DREEM questionnaire scores at Rural 2 were more positive than all the other sites, with a DREEM total score coefficient of 16.92 ($p<0.01$), corresponding to 15.6 points higher score, as can be seen in table 4.20.

Table 4.20. DREEM Total Score, N= 112, R-squared= 0.16, R= 0.4

DREEM_total	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	1.72	4.57	0.38	0.71	-7.35	10.79
Rural 1	-3.68	6.01	-0.61	0.54	-15.59	8.23
Metro 2	-10.71	7.11	-1.51	0.14	-24.81	3.39
Rural 2	16.90	5.41	3.12	0.00	6.17	27.63
Age started Y3	-.76	.47	-1.61	0.11	-1.69	.18
bonded	-3.15	5.59	-0.56	0.57	-14.24	7.94
gamsat	.21	.47	0.45	0.66	-.73	1.15
rural_stud	4.12	4.74	0.87	0.39	-5.29	13.53

The following are extra items added to the end of the DREEM questionnaire at the request of the joint heads of the Deakin University School of Medicine clinical schools, to enquire into several specific questions they wished to address.

Item. 51. **External employment did not interfere with my performance**

The survey results indicated this was not a problem for most students, and there was no statistically significant difference between any of the smaller sites & Metro 1.

Item.52 **Family commitments interfered with my performance**

For each year older there was an increase in perception that family commitments interfered with a student's performance, with a multivariate coefficient of 0.05 (p=0.03), that is, 0.05 higher scoring on the 5 point Likert scale for every year older. However, there was no significant difference in year 3 or year 4 assessment results relating to age, when the DREEM results were included in the regression analysis (table 4.19).

Rural 2 students displayed a negative correlation with regard to the perception that family commitments interfered with performance, when compared to Metro 1, coefficient -0.52 (p=0.04).

Table 4.21. Family commitments interfered with my performance

deakin2	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	-.23	.21	-1.08	0.28	-.65	.19
Rural 1	.35	.28	1.24	0.21	-.21	.92
Metro 2	.58	.36	1.64	0.10	-.12	1.29
Rural 2	-.52	.25	-2.08	0.04	-1.01	-.03
Age starting Y3	.05	.02	2.15	0.03	.00	.09
Rural Bonded	.14	.26	0.53	0.60	-.37	.64
Rural_b'ground	-.04	.22	-0.17	0.86	-.47	.40
Rural 3	.28	.30	0.95	0.34	-.30	.85
GAMSAT	-.04	.02	-1.67	0.10	-.08	.01

Item. 53 **Commuting to placements did not adversely affect my performance**

Metro 2 students responses indicated they felt commuting did adversely affect their performance, relative to Metro 1 students, coefficient -1.53 (p=0.00).

Also, across all sites, males felt it did, more so than females, with a coefficient 0.47 (p=0.01).

Table 4.22. Commuting to placements did not adversely affect my performance

deakin3	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	.47	.16	2.87	0.01	.15	.79
Rural 1	.12	.22	0.56	0.58	-.31	.56
Metro 2	-1.53	.27	-5.62	0.00	-2.07	-.99
Rural 2	.55	.19	2.89	0.01	.17	.93
Age starting Y3	-.01	.02	-0.81	0.42	-.05	.02
Rural Bonded	-.19	.20	-0.95	0.35	-.58	.21
Rural_b'ground	.11	.17	0.63	0.53	-.23	.45
Rural 3	-.35	.22	-1.57	0.12	-.79	.09
GAMSAT	.00	.02	0.19	0.85	-.03	.04

Rural 2 students felt commuting did not adversely affect their performance relative to Metro 1 students, coefficient 0.55 (p=0.01). See table 4.12 (Appendix 3)

Item. 54 **I would recommend my clinical school to others**.

Eastern students mean score fell in the 'uncertain' to 'agree' range, with males scoring 2.3, and females, 2.8.

Relative to Metro 1, Metro 2 students mean score had a significant negative correlation, with a multivariate coefficient of -0.84 (p=0.00), indicating Metro 1 students were significantly more satisfied with their clinical school (table 4.23).

Conversely, Rural 2 students provided a significantly higher mean score than Metro 1, coefficient 0.45 (p=0.03).

Table 4.23. I would recommend my clinical school to others.

deakin4	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gender	.18	.17	1.05	0.30	-.16	.51
Rural 1	.21	.23	0.94	0.35	-.24	.66
Metro 2	-.84	.28	-2.97	0.00	-1.40	-.28
Rural 2	.45	.20	2.24	0.03	.05	.84
Age starting Y3	-.02	.02	-1.13	0.26	-.05	.01
Rural Bonded	-.10	.20	-0.49	0.63	-.50	.30
Rural_b'ground	-.00	.18	-0.01	0.99	-.35	.34
Rural 3	-.30	.24	-1.23	0.22	-.77	.18

Chapter 5. Discussion and Conclusions

Introduction

The results of this study support the null hypothesis that final year medical students' assessment performance is not adversely influenced by their experience within the smaller clinical schools utilised by Deakin University School of Medicine. These data support the idea within the literature that dispersed clinical education sites do not disadvantage medical students, compared to their colleagues at traditional, large, metropolitan, tertiary centres (Bianchi et al., 2008, Carney et al., 2005, Schauer and Schieve, 2006, Sen Gupta et al., 2010, Waters et al., 2006). Further, evidence from this study indicates that small, rural clinical training sites produce superior assessment results, in comparison to those obtained at large, tertiary centres.

Outline of study findings

The highest mean assessment results, and DREEM scores, were attained by students at the site that met both these criteria, Rural 2. Analysis of the data in this study supports the idea that medical students perform better at sites with smaller numbers of students and/or smaller health services. Evidence from the literature suggests possible explanations for these findings: "the smaller realm of the medical world in a rural area was considered an advantage in providing more hands on experience and more inter-professional team approaches to health care provision" (Birden and Wilson, 2012,page 3); "community based students all described themselves as having excellent

access to patients" (p. 111), whilst "the desire to have less competition for patients was a common theme of the tertiary based students" (Worley et al., 2006)page 111.

This study adds further support to the idea found in the literature that an important factor in the development of a medical student is the experience of their educational environment. A more intimate relationship with patients and supervisors is enabled through small group clinical education; thus, allowing the devotion of oneself to the care of the patient (Worley et al., 2006). In the study by Hauer et al (2012) "students highlighted the value of being known to their supervisors. Students felt respected when supervisors recognized their faces, knew their names, and included them in patient discussions." (p.1390)…." feeling surprised and satisfied that attendings acknowledged them in the hospital or used their names. They felt discouraged when supervisors seemed not to know them, did not appear to have time or motivation to engage them while also caring for patients, or did not introduce them to patients" (p.1391).

The guide to interpreting the DREEM total, and component, scores suggested within "A Practical Guide to using the Dundee Ready Education Environment Measure (DREEM)" (McAleer & Roff, 2013) can be found, in full, in appendix 1. In brief, the DREEM total score is out of 200, and can be interpreted as follows:

0-50 Very poor

51-100 Plenty of room for improvement

101-150 More positive than negative

151-200 Excellent

The mean total DREEM score for the combined responses from all clinical sites within the Deakin School of Medicine was 140.9. This compares favourably with results from other schools internationally. Dunne et al (Dunne et al., 2006) reports seven studies involving medical schools across the Middle East returned total DREEM scores ranging from 107 to 130, and Ali et al (Ali et al., 2012) notes six studies of medical schools, from Europe, the UK, & Australia, that produced a range of mean DREEM scores between 139 and 145. The Rural 2 site, with its small number, of exclusively Deakin medical students, within a rural location returned a mean DREEM score of 154, which is appreciably higher than all those scores reported above, and was significantly higher than this studies reference tertiary centre, Metro 1.

Although there was a significant difference in assessment score at the end of year 3 between students with previous clinical experience, and those without, there was no such significant difference in assessment score between those student groups in either year 2 or year 4 of the course. This is congruous with those students with previous clinical experience being comfortable with the clinical environment of the first clinical year within the course, commencing clinical training already possessing both the emotional familiarity with working in the clinical environment, and the skills required to perform as a clinician within a clinical setting. Whilst those without previous clinical experience could be expected to require some time, and experience, to adjust to the new environment. By fourth year those with no previous clinical experience appear to have adapted well, as there was, once more, no significant difference in assessment score between them and the students who had previous clinical experience.

An important part of the founding mission of the Deakin University School of Medicine is to serve the communities of western Victoria, with the stated goal of creating doctors interested in pursuing their career in rural and regional areas (Deakin University, 2012). As part of the effort to obtain this goal, extra admission score weighting is awarded to candidates coming from a rural background. Despite this, the students enrolled in the first two years of the new course were predominantly from a metropolitan background (73%), as displayed in figure 4.4 (Appendix 2). Although, it is likely to be another ten years before it begins to become apparent whether graduates of the school are indeed entering the rural medical workforce in greater numbers than any other medical school, it would appear worthwhile for the school to review whether its admission policies are indeed supporting the schools avowed values and mission.

The results of this study support the idea that learning within a rural small clinical site does not disadvantage medical students academically, or socially. The Dundee Ready Educational Environment Measure (DREEM) score interpretation finds that the Deakin University clinical school sites all rate well, within the 100-150 out of 200 range, with the students who replied to the DREEM survey. The Rural 2 site rated significantly higher than the reference site, which correlates with the higher assessment results at that site. Rural 2 students consistently rated their educational experience in a higher category, across the sub-categories of the DREEM, using the guide recommended by McAleer and Roff (2013). There was no significant difference in mean DREEM scores at the other sites.

Further research

A much greater percentage of students returned completed DREEM questionnaires from the smaller, rural clinical sites- Rural 1, Rural 2, & Rural 3. Only 44% of the students at the tertiary centre, Metro 1, returned a DREEM questionnaire; whereas, the response rate from the smaller sites ranged from 54%-88%, and that of the rural sites ranged from 61%-88%. This raises the question, what is it about the smaller, rural schools that has produced such a response? Is it a sense of belonging to a community? Does a more positive educational experience increase the response rate? At both Metro 1 and Rural 1 the gender group with the lower DREEM results had the higher DREEM response rate. Gender itself seemed to have a greater influence on response rate than perception of educational environment, with females responding at a greater rate than males at 3 of the 4 sites; this is consistent with the literature regarding survey response rates among University students.

Adams and Umbach (Adams and Umbach, 2012) have found "relatively recent literature on participation in web-based surveys also seems to demonstrate differences in the likelihood of response among students at universities" (p.578); "for example, females are more likely to respond than males" (p. 578), "students in realistic majors were 1.16 times more likely than social majors to respond" (p.583), and "grades were also influential factors of participation"…."low grades (Ds and Fs) correlated with SET nonresponse when compared with grades of A, B, C, and S at a statistically significant level" (p.583).

Further research employing the post-positivist approach, involving interviews, and/or focus groups, appears to be warranted, to further analyse the experience of students at the respective clinical sites. This may provide greater insights into the variation of assessment results between sites, and potentially uncover areas for improved educational experiences and outcomes.

The results to item 54 correlate well with the DREEM data. The DREEM mean total score for Rral 2 was the highest, Metro 1 the second highest, and Metro 2 the lowest. This simple question may well substitute for the DREEM questionnaire with regard to the total DREEM score, but lacks the explanatory nature of the component scores and the individual items within the DREEM. Perhaps a study looking at the validity of a 2 item survey- 1. I would recommend my clinical school to others, and 2. Why?- in comparison with the 50 item DREEM questionnaire would be warranted.

PRISMS and Symbiosis

The Deakin University School of Medicine has been born out of, and its' development influenced by, the dramatic evolution of medical education that has swept the globe in recent decades. The practice of medicine has changed, and after overcoming significant initial inertia, medical education has now radically changed, to be almost unrecognisable to most medical students of 20 years ago. Student numbers have exploded, traditional teaching hospitals have increasingly become dominated by sub-specialties dealing with short term acute management, and many chronic conditions are entirely managed elsewhere; all with regard to evidence based management and

cost effectiveness. This evolution has led to the educational context in which the Deakin medical course has emerged and thus to the need for this study.

Bligh et al (Bligh et al., 2001) have encompassed this reality, together with the educational principles of learner autonomy, the benefits of group learning, critical reflection on practice, and in practice, with learning that is context based, relevant and meaningful to the learner, within their suggested PRISMS model. They espouse medical education should be Product focused, emphasising clinical practice and being practice based whenever possible; Relevant to both communities and students; Inter-professional, encouraging cooperative team based approach to education, research & clinical practice; involve Shorter medical courses, with mature age entrants, and Smaller learner group sizes; Multi-site dispersed education, to allow for smaller groups and exposure to a greater breadth of clinical conditions; and, finally, be composed of Symbiotic relationships amongst learners, teachers, institutions, communities and governments. The strong performance of the students based in the rural Deakin sites, and especially the Rural 2 clinical site, where these principles are embedded, supports the arguments of Bligh, et al.

The clinical education model of Symbiosis, which was further expounded in the study "Empirical evidence for symbiotic medical education: a comparative analysis of community and tertiary-based programmes" (Worley et al., 2006), may help explain the strong assessment performance by the students based at the smaller, rural clinical sites within the Deakin School of Medicine. Symbiosis can refer to the degree to which students perceive their value within four major dimensions of the clinical environment: patient- clinician, health service- university/ research, community- government, and

personal principles-professional expectations. As discussed in the study by Worley et al, a student may achieve a greater experience of the patient- clinician relationship in a smaller clinical setting, with greater opportunity to be 'hands on' in patient management, acting as part of the health care team; whilst, in the tertiary setting students often feel more like on-lookers. Students may feel more valued by the staff of a smaller centre, rather than supernumerary, as indicated by this quote from a student in the study by Worley et al (2006, p.114): "if a clinician actually remembers your name from one tutorial to the next and shows an active interest in your learning then it's a lot easier to learn".

Also, students may feel more valued by the community in a smaller centre, through interactions such as the annual City Council civic reception for arriving medical students at the Rural 2 site, patient enquires as to whether they will be returning as country doctors, and involvement in community activities- such as joining a local sports team, or presenting health education sessions to local school children. Finally, a student's personal/professional development can be aided through closer ongoing contact with one, or more, clinician mentors in a small, rural setting; where they may gain an understanding of a clinician's position in the community, family life, approaches to professional dilemmas, etc. As Worley et al conclude, the "relational nature of medical education should not be unexpected as it resonates with the nature of medical practice, of education and of science, and indeed echoes ancient understandings of the purpose of life itself" (p.115).

Limitations

The variable percentages of returned DREEM questionnaires was a significant limitation of this study. Including the DREEM questionnaire into the multivariate analyses approximately halves the analysis population, as all data from students who did not return a questionnaire is excluded from the analyses. This throws a degree of doubt onto the validity of any results from such analyses, especially when the power of this study starts at an already low level when the total population is included.

A potential bias, as noted previously, that students happy with their academic assessment performance may be more likely to have returned completed DREEM surveys, is supported by the results of this study with the lowest mean DREEM response rates coming from the two clinical schools that had the lowest year 4 assessment mean scores. Correlating perception of educational environment with assessment results was less clear, as there was one glaring mismatch, being the site with the second highest mean DREEM score achieving the lowest year 4 mean assessment score. This site also produced the lowest DREEM response rate. These observations suggest that assessment performance may have a greater influence on survey response rate then satisfaction with educational environment.

Also, the small numbers of students at the smaller clinical sites within this study limits the power of the study. A further study, including subsequent cohorts of students would increase the study participant numbers and alleviate this concern.

An inherent problem in clinical education studies is that of student allocation to groups within a study. Student allocation may have influenced the results in this study. The Deakin University School of Medicine method of allocation was based on student preferences. It is interesting to note when student preferences were reviewed by the primary researcher, there had been only one first preference for the Rural 2 clinical site in each of the year cohorts involved in this study (personal communication from Professor Brendan Crotty, inaugural Head of School, 2012); all the other Rural 2 students had higher preferences for alternative clinical sites.

Examination of the mean GAMSAT results for the students in this study suggests that students of similar abilities have not been equally distributed amongst the clinical sites. However, the distribution of year 2 assessment results show a much more even spread across the various clinical sites. Given these results are produced immediately prior to commencing the clinical years of the course, and are produced from examinations of the actual curriculum, they are a much more reliable indicator of the equitable spread of student ability across the sites upon entering the clinical years.

The Hawthorne effect, which refers to the phenomenon whereby the behaviour of study participants may be influenced by the very fact of their being observed, may have influenced this study. This is relevant due to the first two cohorts of Deakin University School of Medicine students being closely monitored, and repeatedly surveyed, as they progressed through the years, to allow fine tuning of the delivery of a fledgling course.

Conclusion

The results of this study do not support the idea that clinical education at small and/or rural sites is inferior to that at the traditional large urban centre. Indeed, it provides an indication that students perform better at the smaller clinical sites, and that medical schools may be better off distributing students across such smaller sites. Both the highest assessment scores, and greatest satisfaction with educational environment, were found at the clinical school with small sized groups of students, allowing faculty to concentrate their time and effort, and develop mentoring relationships.

The Deakin University School of Medicine can be reassured that the students' perception of their educational environment rates highly at each clinical school, and the students at dispersed clinical sites are not academically disadvantaged. However, further study is required to investigate the potential variation in faculty/clinician/student relationships between the clinical schools; also, to mine down into the DREEM survey results, in order to determine the underlying reasons for the variable results between the different clinical schools, with the goal of further quality improvement. A qualitative study, involving interviews and/or focus groups would appear to be warranted, as would a larger study of assessment results to provide a more powerful investigation, ensuring no significant difference in results between clinical schools has been missed.

Appendix 1

DREEM Questionnaire- plus Items 51-54 added at the request of the heads of the clinical schools

Dundee Ready Education Experience Measure Questionnaire

Please tick the appropriate box with your answer

		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1	I am encouraged to participate in teaching sessions					
2	The educators are knowledgeable					
3	There is a good support system for registrars who get stressed					
4	I am too tired to enjoy this course					
5	Learning strategies which worked for me before continue to work for me now					
6	The educators espouse a patient centred approach to consulting					
7	The teaching is often stimulating					
8	The educators ridicule their students					
9	The educators are authoritarian					
10	I am confident about passing this year					
11	The atmosphere is relaxed during consultation teaching					
12	The course is well timetabled					
13	The teaching is student centred					
14	I am rarely bored on this course					
15	I have good friends in this course					
16	The teaching helps to develop my competence					
17	Cheating is a problem in this course					
18	The educators appear to have effective communication skills with patients					
19	My social life is good					
20	The teaching is well focused					
21	The teaching helps to develop my confidence					
22	I feel I am being well prepared for my profession					
23	The atmosphere is relaxed during lectures					
24	The teaching time is put to good use					
25	The teaching over emphasizes factual learning					
26	Last year's work has been a good preparation for this year's work					

		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
27	I am able to memorize all I need					
28	I seldom feel lonely					
29	The educators are good at providing feedback to students					
30	There are opportunities for me to develop interpersonal skills					
31	I have learned a lot about empathy in my profession					
32	The educators provide constructive criticism here					
33	I feel comfortable in teaching sessions socially					
34	The atmosphere is relaxed during seminars/tutorials					
35	I find the experience disappointing					
36	I am able to concentrate well					
37	The educators give clear examples					
38	I am clear about the learning objectives of the course					
39	The educators get angry in teaching sessions					
40	The educators are well prepared for their teaching sessions					
41	My problem solving skills are being well developed here					
42	The enjoyment outweighs the stress of studying medicine					
43	The atmosphere motivates me as a learner					
44	The teaching encourages me to be an active learner					
45	Much of what I have to learn seems relevant to a career in healthcare					
46	My accommodation is pleasant					
47	Long term learning is emphasized over short term learning					
48	The teaching is too teacher centred					
49	The students irritate the educators					
50	I feel able to ask the questions I want					

		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
51	External employment did not impact on my studies					
52	Family commitments interfered with my performance					
53	Commuting to placements did not adversely affect my studies					
54	I would recommend my clinical school to other students					

Interpreting the DREEM questionnaire

The guide to interpreting the DREEM scores suggested within "A Practical Guide to using the Dundee Ready Education Environment Measure (DREEM)" (McAleer & Roff, 2013) is as follows:

Interpreting the overall score:

0-50 Very Poor

51-100 Plenty of Problems

101-150 More Positive than Negative

151-200 Excellent

The DREEM components are Perception of Learning (scored out of 48), Perception of Course organisers (scored out of 44), Academic Self-Perception (scored out of 32), Perceptions of Atmosphere (scored out of 48), and Social Self Perceptions (scored out of 28).

Interpreting the component scores:

Perception of Learning

0-12 Very Poor

13-24 Teaching is viewed negatively

25-36 A more positive perception

37-48 Teaching highly thought of

Perception of Course organisers

0-11 Abysmal

12-22 In need of some retraining

23-33 Moving in the right direction

34-44 Model course organisers

Academic Self Perceptions

0-8 Feelings of total failure

9-16 Many negative aspects

17-24 Feeling more on the positive side

25-32 Confident

Perception of Atmosphere

0-12 A terrible environment

13-24 There are many issues which need changing

25-36 A more positive attitude

37-48 A good feeling overall

Social Self Perceptions

0-7 Miserable

8-14 Not a nice place

15-21 Not too bad

22-28 Very good socially**”**

Appendix 2

Figure 4.5. Number of students, by clinical school & gender

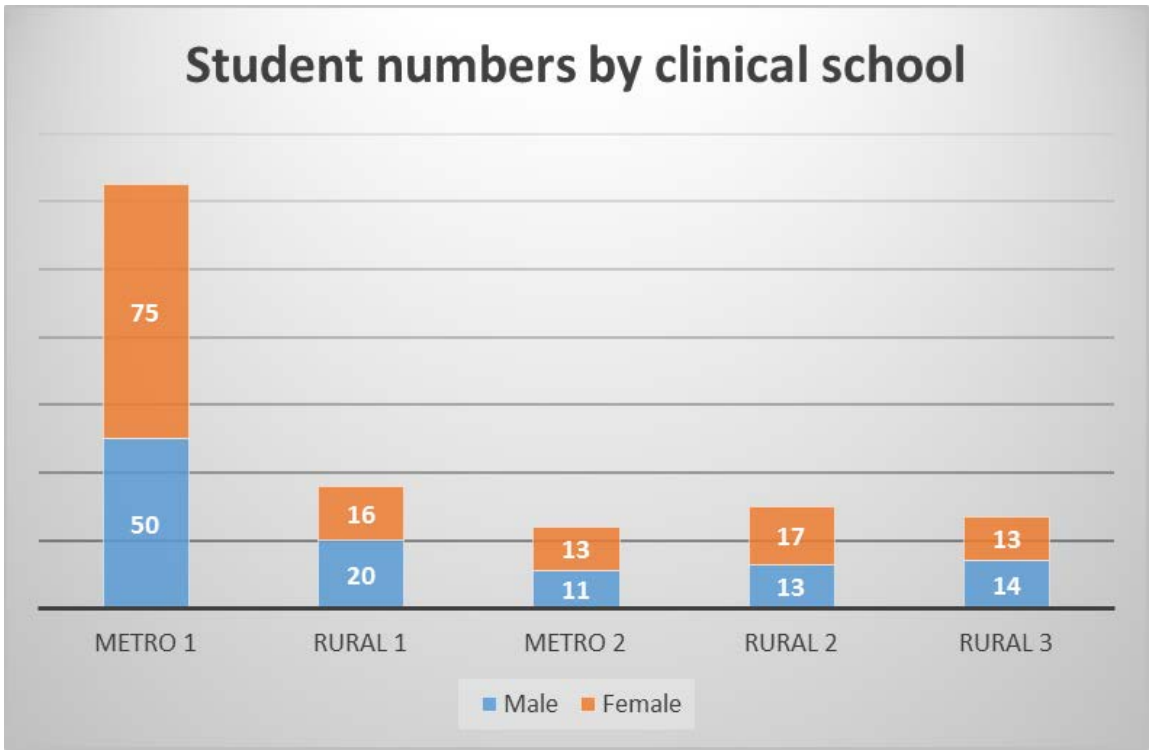


Figure 4.6. Mean age at start of third year, by clinical school & gender

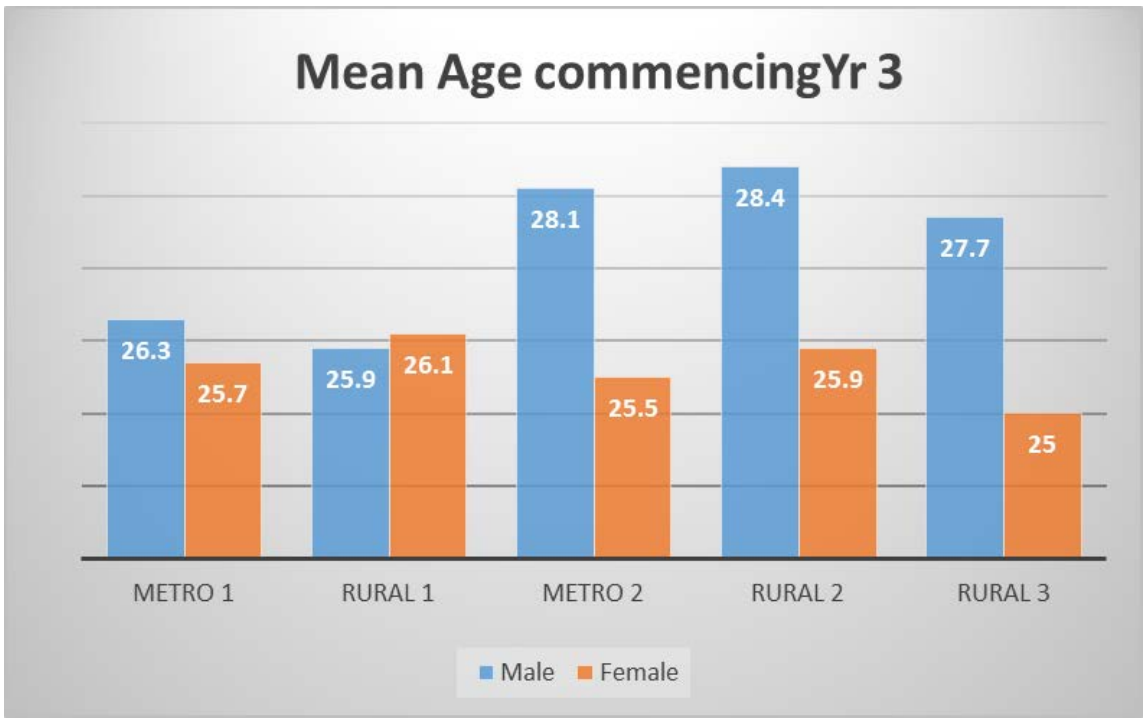


Figure 4.7. Mean GAMSAT score, by clinical school & gender (excluding 2 students with no GAMSAT score)

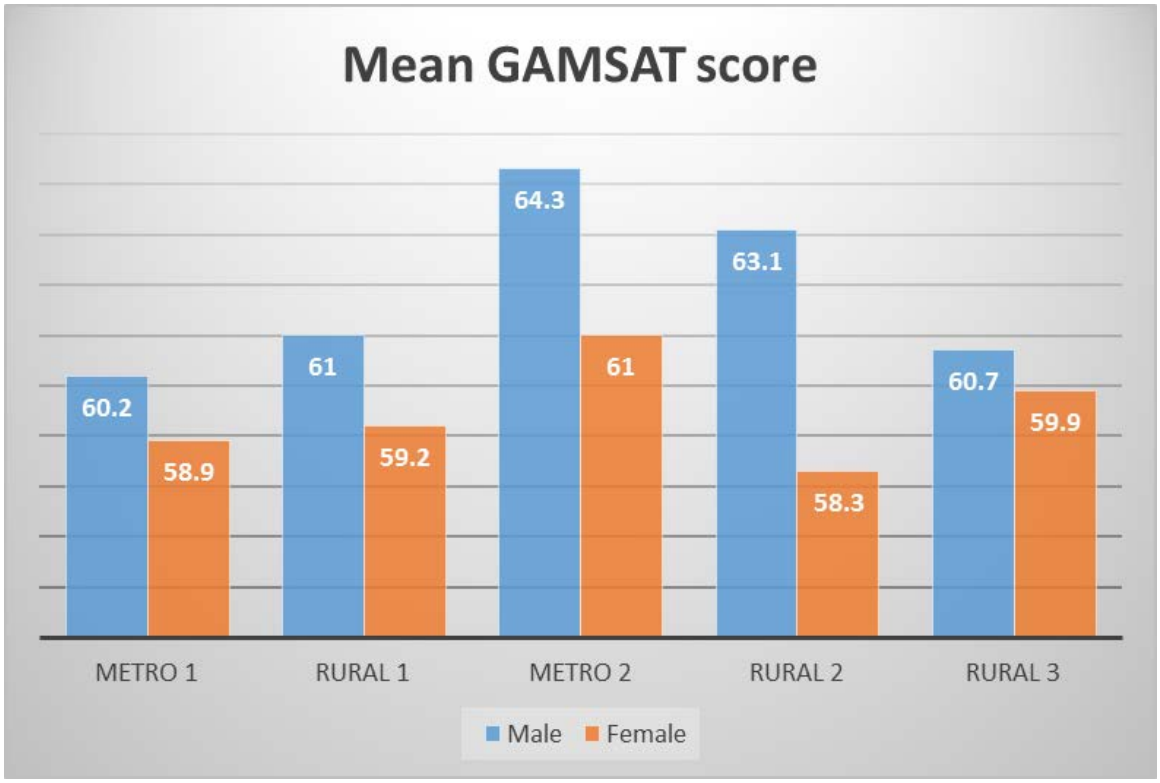


Figure 4.8. Number of students, by clinical school & previous area of residence

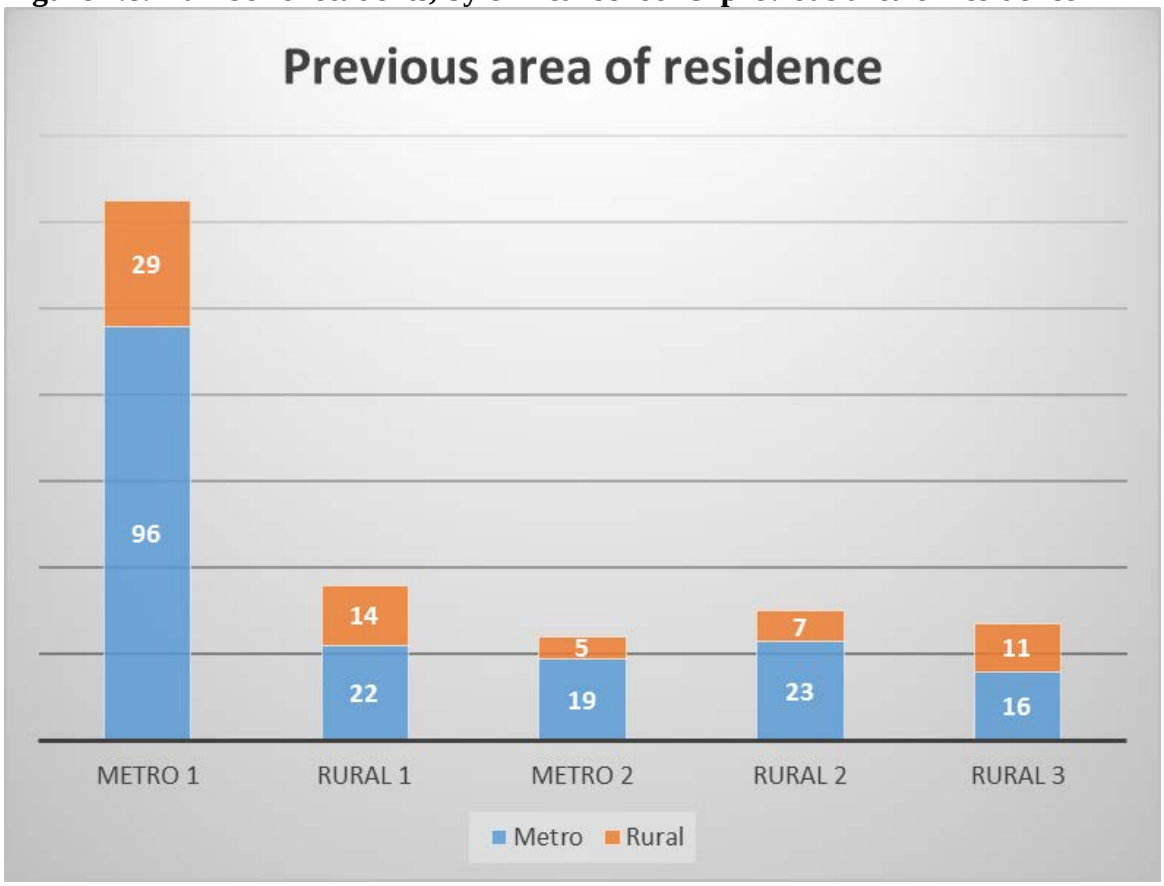


Figure 4.9. Number of students by clinical school & previous clinical experience

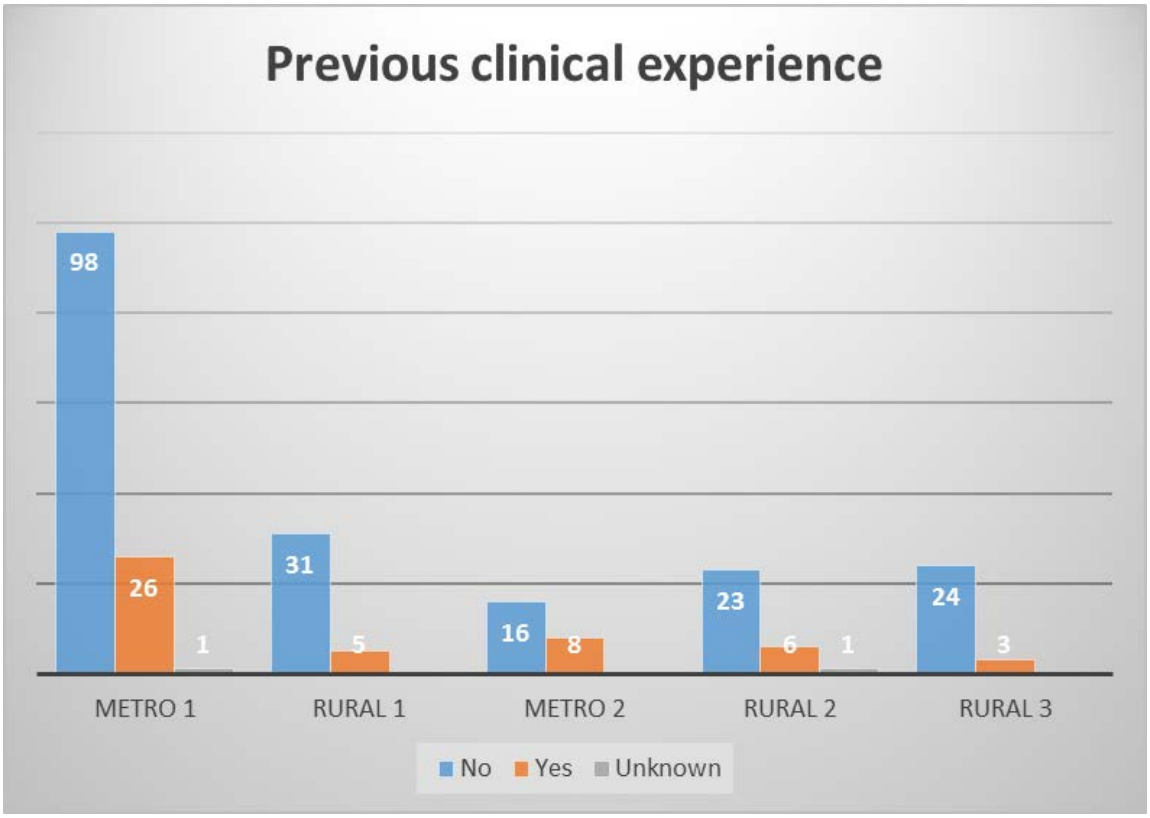
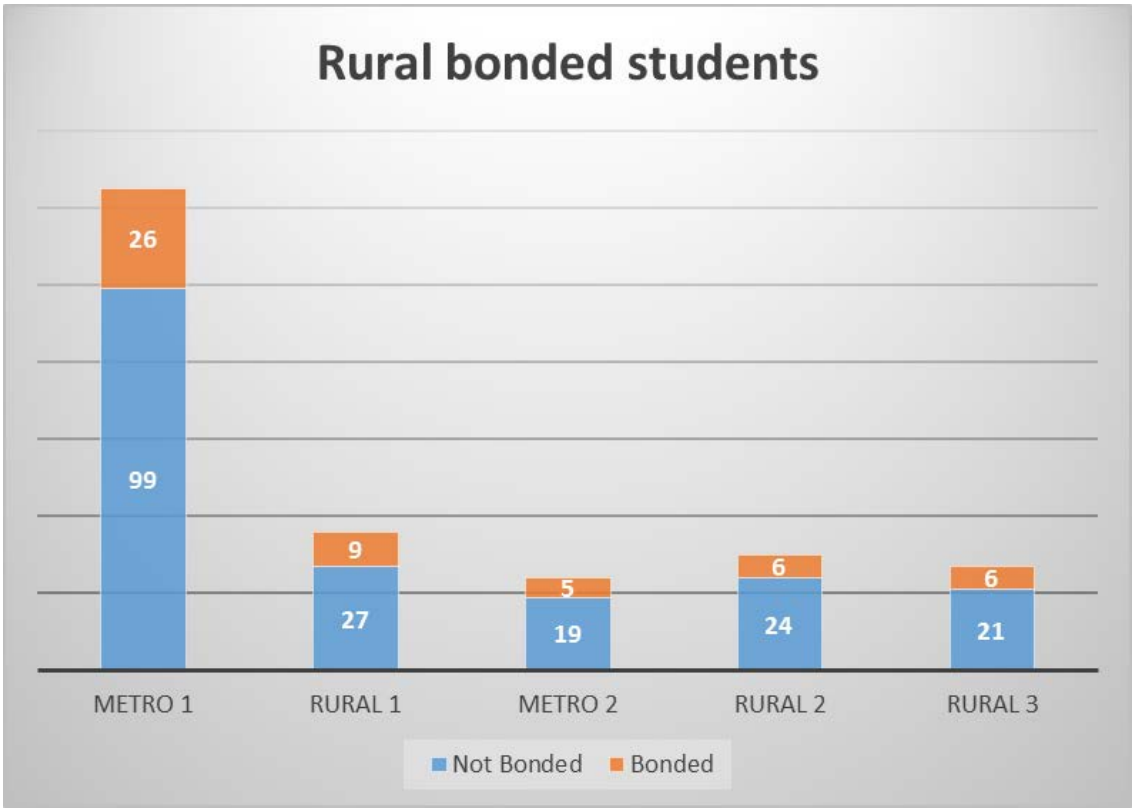


Figure 4.10. Number of rural bonded students by clinical school



DREEM Results

Figure 4.11 Number of students who completed DREEM survey, by clinical school

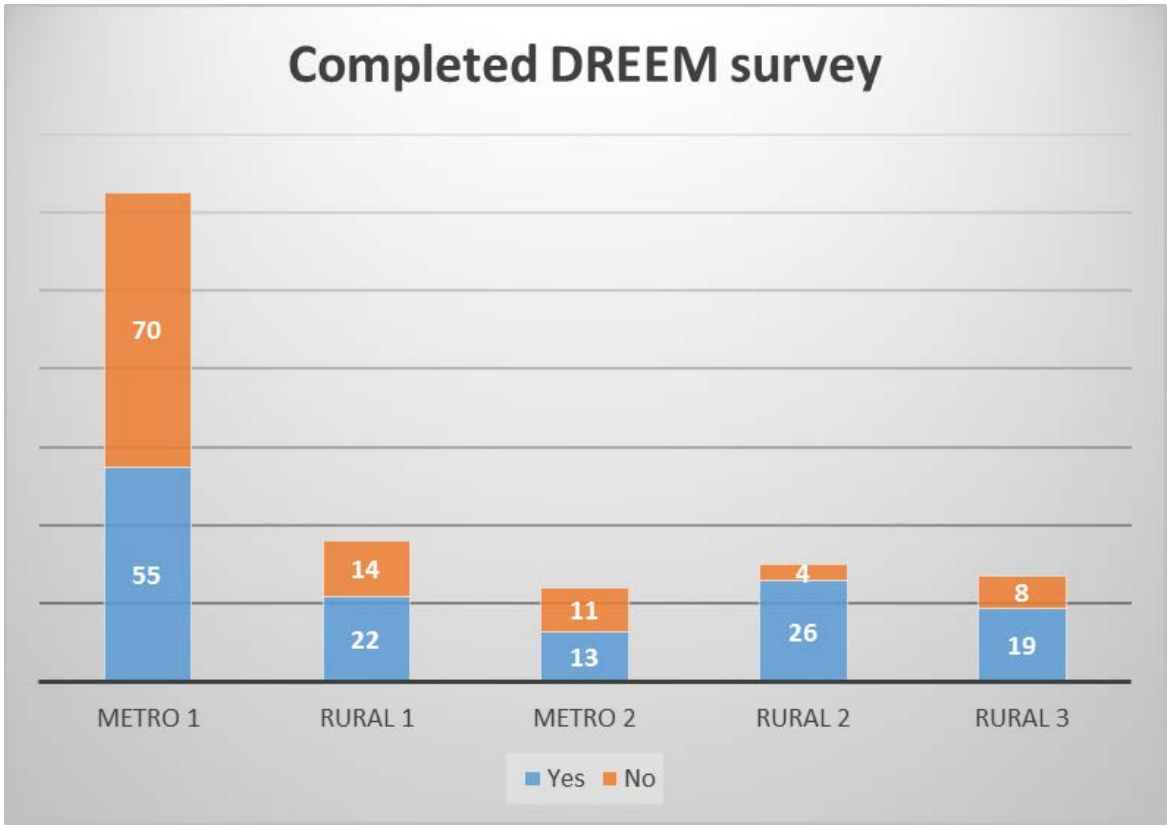


Figure 4.12. Mean DREEM total score, by clinical school

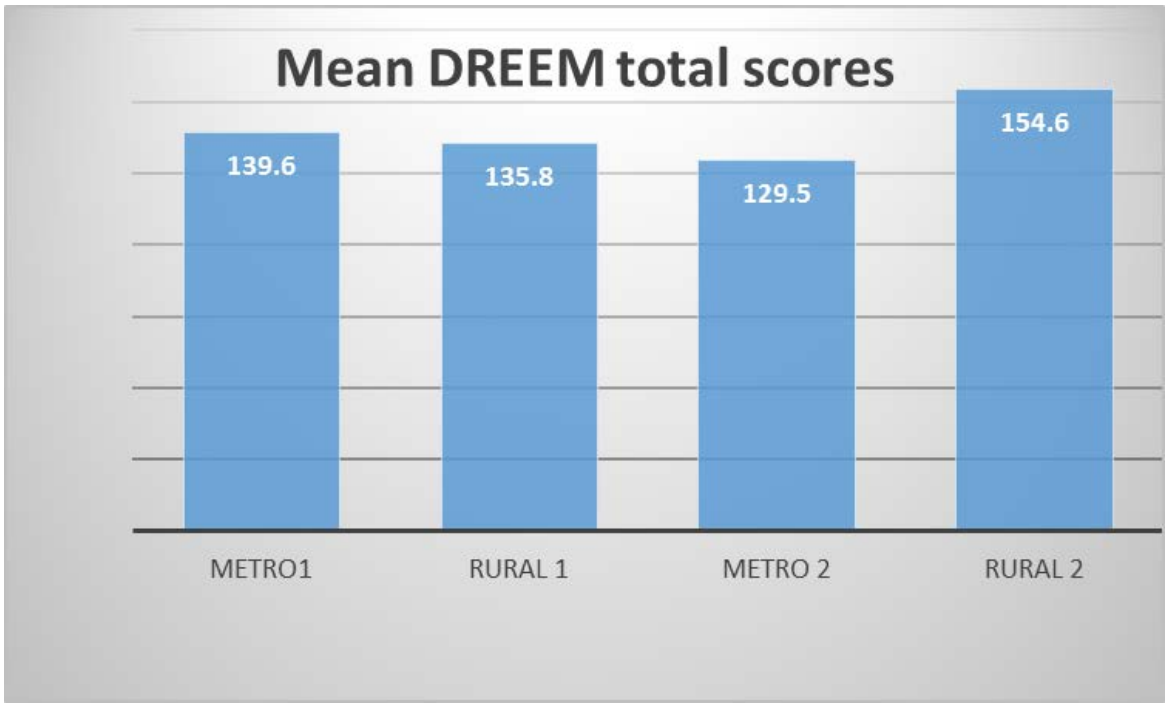


Figure 4.13. Mean DREEM component scores, by clinical school

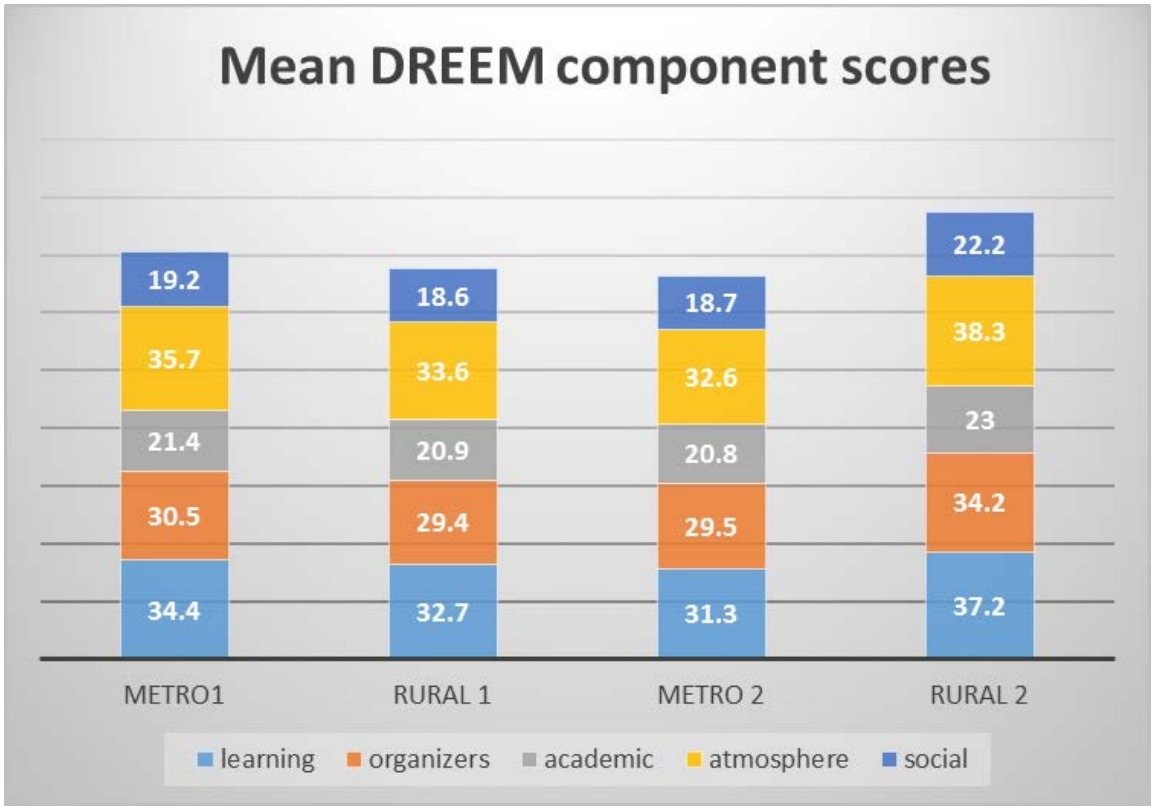


Figure 4.14. Year 2 Mean exam score, by clinical school & gender and year of course

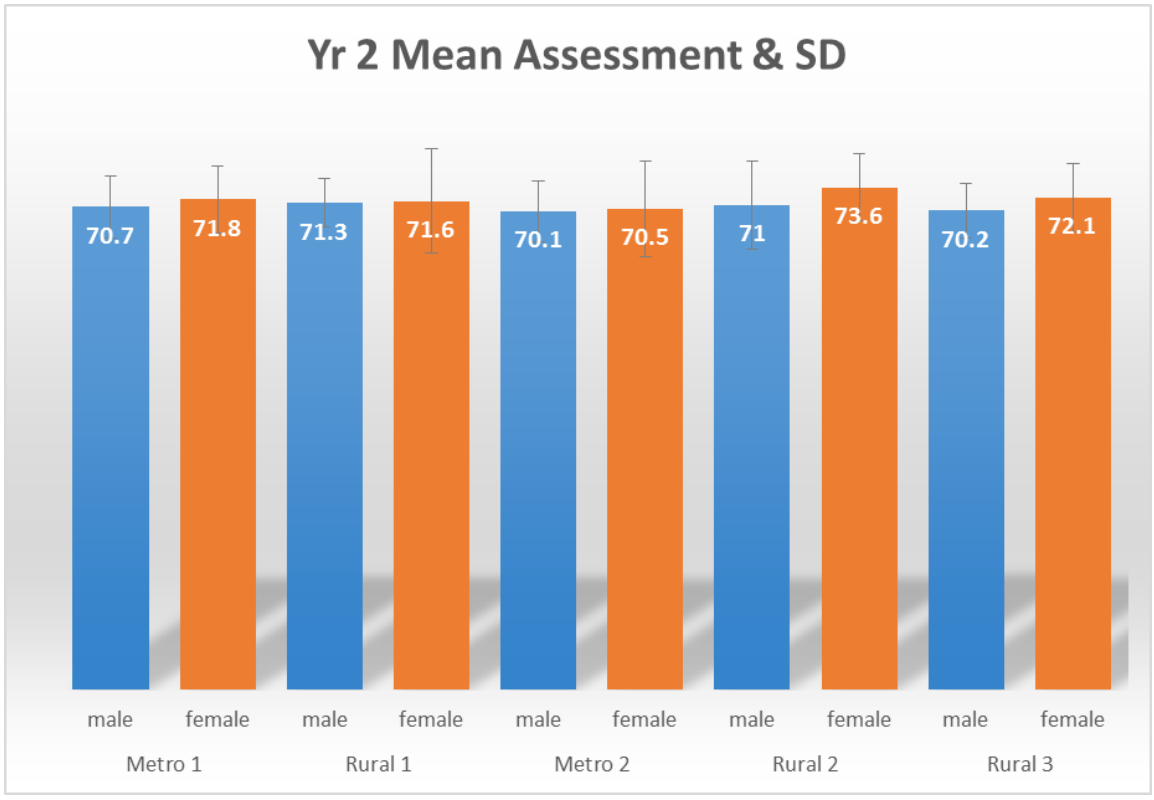


Figure 4.15. Year 3 Mean exam score, by clinical school & gender and year of course

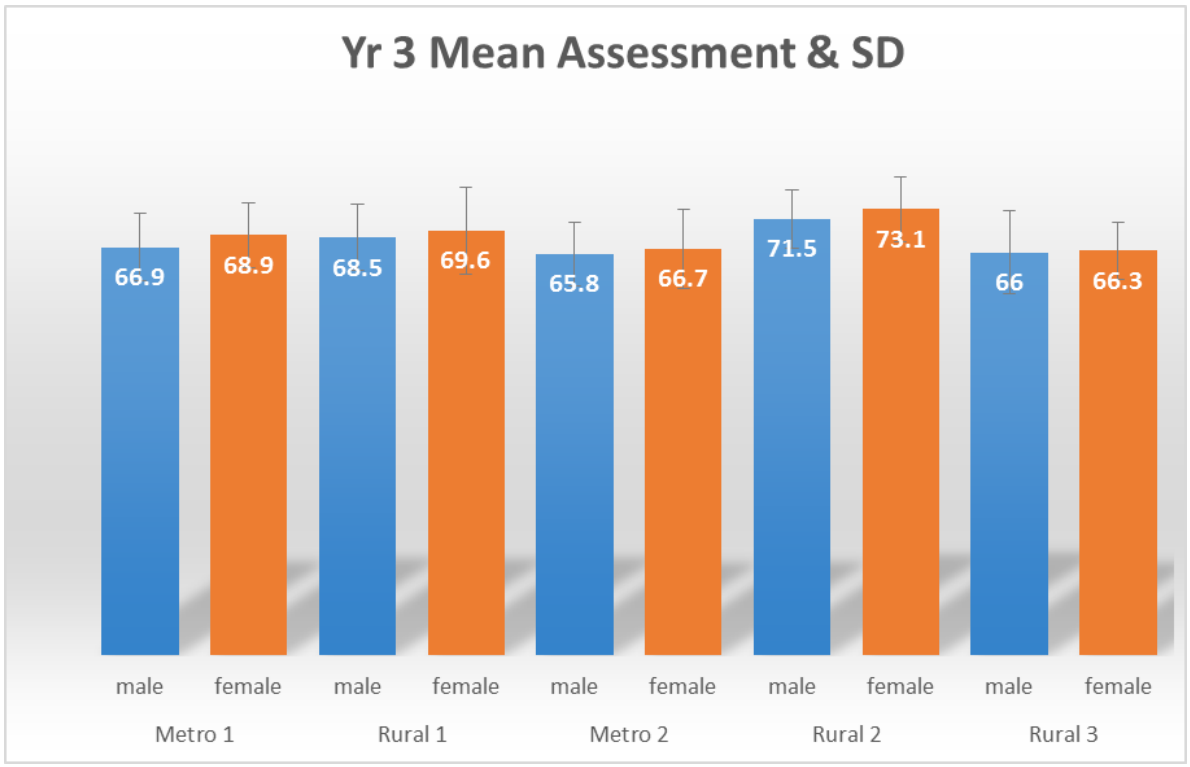
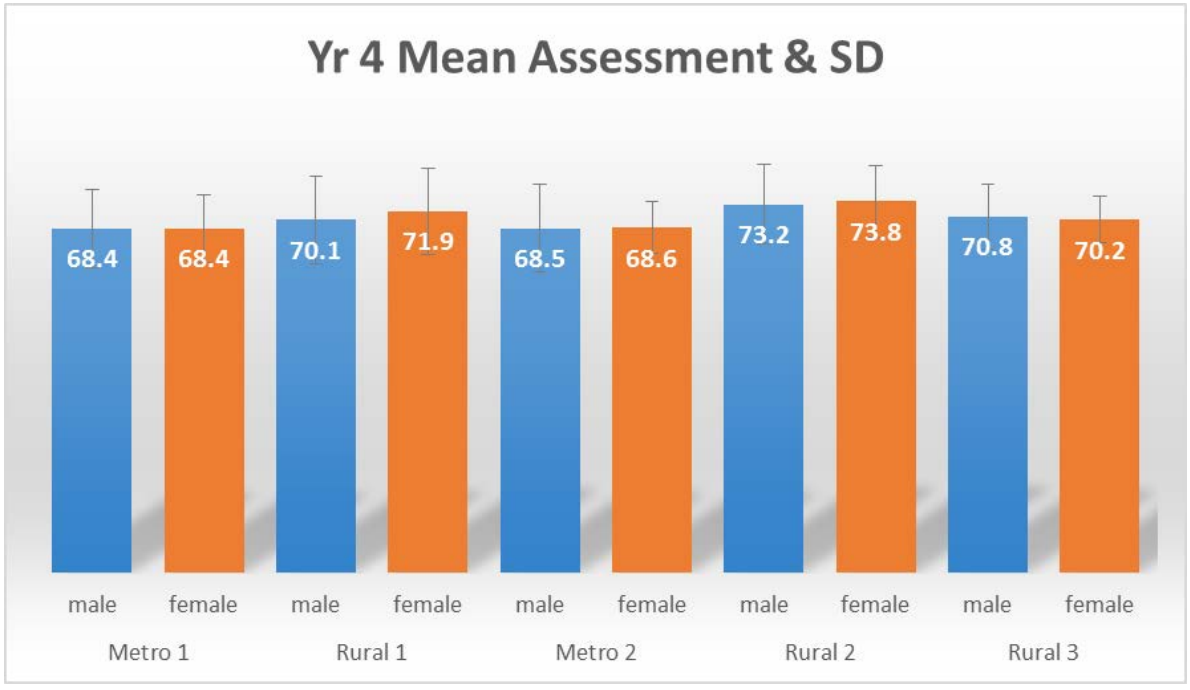


Figure 4.16. Year 4 Mean exam score, by clinical school & gender and year of course



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