

**Predictors of academic performance in the ‘Oral
Biology and Pathology’ paper: A retrospective
quantitative study**

Rohini Khareedi

A thesis submitted to Auckland University of Technology
in partial fulfilment of the requirements for the degree of
Master of Education (MEd)

2015

School of Education

Primary Supervisor: Dr Jyoti Jhagroo

Abstract

Background: The cohort of students enrolled in the Oral Biology and Pathology paper reflects a structural diversity in that it includes students of multiple ethnicities, varied age groups, differing scholastic and life experiences. These divergent identities of students are known to influence academic performance. Academic performance has been a subject of intense research to not only identify at risk students to remediate failure but to also endorse factors that impact academic performance positively.

Purpose: The purpose of this retrospective quantitative study was to determine the ability of a set of variables such as: age, gender, ethnicity, level of prior education, place from which prior education was obtained, work experience and academic performance at university as measured by grades obtained in the prerequisite paper to predict academic performance in the Oral Biology and Pathology paper.

Method: The research approach employed for this hypothetico-deductive retrospective study was the quantitative methodology. The sample for this study was a purposive sample of all students who had enrolled in the Oral Biology and Pathology paper at the Auckland University of Technology from 2011 to 2014. The desensitized empirical data of 116 students from the University's data base was subject to descriptive and inferential statistical analysis.

Results: The multivariable regression analysis demonstrated that the grades obtained in the prerequisite paper was a statistically significant predictor variable ($p < 0.001$) for the academic performance in the Oral Biology and Pathology paper. Pearson's correlation coefficient analysis revealed a statistically significant and a strong positive correlation ($r = 0.641$, $p < 0.001$) between the grades in the prerequisite paper and the grades in the Oral Biology and Pathology paper.

Conclusion: The conclusions from the results obtained in our study is that age, gender, ethnicity, level of education, place from where previous educational qualifications were obtained and work experience were neither correlated to nor predictive of the academic performance in the Oral Biology and Pathology paper. The grades obtained in the prerequisite paper was the only variable that was emphatically demonstrated to be correlated to and predictive of the academic performance in the Oral Biology and Pathology paper.

Though the conclusions drawn cannot be generalized, the inferences drawn have implications for education practice and future research.

Table of Contents

Contents	iii
List of Figures.....	iv
List of tables.....	v
Attestation of Authorship	vii
Acknowledgements	viii
Dedication	ix
Chapter 1: Introduction	1
Chapter 2: Literature Review	6
Chapter 3: Methodology.....	31
Chapter 4: Results.....	39
Chapter 5: Discussion	60
Chapter 6: Conclusion	70
References	76

List of Figures

Figure 1: Pie Chart Showing the Distribution of Ethnicity in the Sample.....	40
Figure 2: Bar chart showing distribution of the sample by Age	40
Figure 3: Histogram of the final regression model with the Oral Biology and Pathology grade (grade_coded) as the dependent variable	57
Figure 4: P-P Plot of Regression Standardized Residual	58

List of tables

Table 1:	List of variables.....	32
Table 2:	Recoding of Variables.....	36
Table 3:	Distribution of Students Aged 25 and Under & Over 25.....	41
Table 4:	Distribution Frequency of Students by Prior Qualifications.....	41
Table 5:	Distribution Frequency by Place from Where Prior Qualifications Were Obtained.....	42
Table 6:	Comparing Means of the Scores in the Oral Biology and Pathology Paper between Those 25 and Under and Those Over 25	43
Table 7:	Comparing Means of the Scores in the Oral Biology and Pathology by Gender	44
Table 8:	Comparing the Means of the Scores in the Oral Biology and Pathology Paper by Ethnicity.....	44
Table 9:	Comparing Means of the Scores Obtained In the Oral Biology and Pathology Paper between Students with Prior Tertiary Education and Those with Secondary Education	45
Table 10:	Comparing Means of the Scored Obtained In the Oral Biology and Pathology Paper between Students with Had Obtained Prior Education in New Zealand with Those Who Had Received Prior Education Overseas	46
Table 11:	Comparing the Means of the Scores in the Oral Biology and Pathology Paper between Students with and Without Work Experience	46
Table 12:	Bivariate Correlation Analysis between Oral Biology and Pathology Grade and the Two Age Groups	48
Table 13:	Bivariate Correlation Analysis between Oral Biology and Pathology Grade and Ethnicity	49

Table 14: Bivariate Correlation Analysis between Oral Biology and Pathology Scores and Gender	50
Table 15: Bivariate Correlation Analysis between Oral Biology and Pathology Grade and Level of Prior Education	51
Table 16: Bivariate Correlation Analysis between Oral Biology and Pathology Scores and Place of Prior Education.....	52
Table 17: Correlations between Oral Biology and Pathology Grade and Work Experience	53
Table 18: Correlations between the Grade in the Oral Biology and Pathology Paper and the Grade in the Prerequisite Paper	54
Table 19: One-Sample t Test – Comparing Means of the Scores Obtained in the Oral Biology and Pathology Paper with the Means of the Scores Obtained in the Prerequisite Paper	55
Table 20: Multivariable Regression Analysis Using All Variables	56
Table 21: Model Summary of the Multivariable Regression Analysis Using All Variables	56

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Rohini Khareedi

Acknowledgements

I would like to express my sincere gratitude to my supervisor Dr Jyoti Jhagroo for the guidance and continuous support. I am grateful for her insightful comments and encouragement, both of which have motivated me to complete this thesis.

This study would not have been possible without the desensitized data. I am appreciative of the lengths that David Homan, Director (Student Services) and his team went to make the data available for this study.

I would like to thank Steve Taylor, Biostatistician for his advice on the statistical methods.

Dedication

This work is dedicated to all my teachers and students. All of whom have been and continue to be my constant source of inspiration.

Chapter 1: Introduction

Despite advances in science and technology, considerable inequalities in oral health still plague society with its colossal social and economic costs. Though the most common diseases affecting the gums and the teeth are preventable, they continue to contribute to morbidity across the lifespan especially in the vulnerable populations. Those from low socio-economic strata and ethnic minorities living in socially disadvantaged areas face deprivation and are affected by low health outcomes.

Universally policy-makers agree that one of the ways of addressing health inequalities is through increasing active participation of people from all communities. Engagement in higher education is known to enable active participation. Universities have adopted an equal opportunities policy and have widened access to a broader spectrum of students from diverse backgrounds by modifying their acceptance criteria for enrolment. Such policies are believed to be mechanisms that enhance social mobility and social justice (Hoare & Johnston, 2011).

The diverse cohort of students with its compositional shift is believed to provide learning opportunities by “integrating complex understandings of forms of difference” (Chang, 2013, p. 172) while also resulting in an “educated, self-sustaining populace that contributes to society” (Lee, 2002, p. 367). Universities are striving to fulfil their responsibility of producing a workforce that not only meets the current and future needs of society but is also representative of the population (Shulruf, Poole, Wang, Rudland, & Wilkinson, 2012).

The effect of such non-homogenous student populations on education outcomes has been debated and researched (Kuncel, Wee, Serafin, & Hezlett, 2010). While it has been agreed that heterogeneity in terms of age, gender, sexual orientation, ethnicity, level of prior education, work experience, life experience among other things leads to divergent thinking and perspective taking, its impact on knowledge acquisition and skill development has less consensus among researchers (Kivlighan, 2008).

Student learning is assessed by measuring academic performance. Academic performance in tertiary education has been a prevalent subject of intense research for many decades for multiple stakeholders including accreditation agencies, governments and the society at large. The academic performance of students with varied background characteristics while at

university has stimulated vast research on not only the cognitive measures but also on the non-cognitive attributes. Several performance predictors have been identified as being contributory to academic success. These include academic, cognitive, psychosocial and demographic variables (Li, Chen, & Duanmu, 2010). While some researchers have demonstrated high school grade point average to be the most reliable predictor of academic performance at university (Downey, Collins, & Browning, 2002; Maslov Kruzicevic, Barisic, Banozic, Esteban, Sapunar, & Puljak, 2012; Nout & Aishah, 2014), others have demonstrated aptitude tests and interviews to be more reliably predictive (Buyse & Lievens, 2011), still others have demonstrated attributes like motivation, emotional intelligence, academic goals and other non-cognitive measures as viable predictors for academic success (Kornguth, Frisch, Shovein, & Williams, 1994; Yip & Chung, 2005).

While many studies have concluded that certain demographic and experiential characteristics are predictive of academic performance in tertiary education (Kim & Lee, 2007; Lambe, & Bristow, 2011; Uppal, & Mishra, 2014). Others have empirically demonstrated that skills acquired at university in the first year of study are more reliable than the demographic and experiential characteristics of students at the time of admission into university in predicting subsequent academic performance (Bartlett, Peel, & Pendlebury, 1993; Tumen, Shulruf, & Hattie, 2008).

The rationale for research on academic performance has had varied objectives, one of which has been to remove the impediments of academic success and remediate failure in at risk students. It is critical that valid academic predictors are identified to support at risk students (Whyte, Madigan, & Drinkwater, 2011). However the outcomes of the various research endeavours in multiple fields of education at numerous universities are not only conflicting but are also context specific and therefore cannot be generalized.

My personal context

The curriculum for training oral health practitioners entails basic sciences and clinical sciences to facilitate the acquisition of cognitive, affective and psychomotor skills that are needed for effective clinical practice. A solid grounding in biosciences is considered vital for rational thinking, problem solving and complex decision making in clinical situations. Knowledge of biological concepts helps with developing an insightful understanding of

clinical phenomenon and provides a scientific basis on which clinical diagnoses and treatment can be carried out (Davies & Warfvinge, 2003). Oral health educators have the task of preparing students to become competent practitioners who can apply science-based evidence to clinical practice. During the tenure at university, the students' academic performance is a measure of their competency. Academic performance in the biosciences has been empirically demonstrated to be a positive predictor of subsequent academic performance in the clinical subjects (Wong, & Wong, 1999) and in licensure examinations (Peterson, & Tucker, 2005).

I am involved with coordinating the teaching and learning activities in the Oral Biology and Pathology paper, a knowledge based, discipline specific bioscience paper for the second year students enrolled in the Bachelor of Health Science (Oral Health) programme at the Auckland University of Technology in New Zealand. The 'Oral Biology and Pathology' paper bridges the gap between the basic sciences and the clinical sciences. This paper deals with the development, structure and functions of oral and perioral tissues in health and disease.

The cohort of students I am involved with now is very different from my peer group as a student. I was seventeen when I started dental school and all my classmates were either seventeen or eighteen years old and the male to female numbers were almost equal with no remarkable imbalance in student gender. We seem to have had more similarities than differences. When I started my teaching career at AUT, I felt challenged by the diversity of the student cohort. There were students from different ethnicities, varied age groups, albeit mostly female. There were some school-leavers, some students with prior tertiary education, and some students who were returning to study after having left school years earlier. Some students had work experience in the dental industry, while others had worked in other fields and some had no work experience. Some had children, some were in relationships, and some were single. There were "pluralities of identities" with respect to age, gender, ethnicity, personality, prior life experience, level of prior education, level of academic achievement, work experience among other things (Ghosh, 2012, p. 351). I have often wondered if having work experience influences the academic performance in the 'Oral Biology and Pathology' paper or if returning to tertiary education after being away from an academic environment for many years has any effect on academic performance or if the level of prior education influences academic performance in this paper.

Purpose

The purpose of this retrospective quantitative study was to determine the ability of a set of variables such as: age, gender, ethnicity, level of prior education, place from which prior education was obtained, work experience and prior academic achievement as measured by the grades obtained in the prerequisite paper; to predict academic performance in the Oral Biology and Pathology paper. The objective is to enhance student performance in the paper by using the results to design support programmes.

Significance of the Study

The results of this study will not only provide data regarding predictors of academic performance in the discipline specific bioscience paper that could be used for supporting at risk students but will also possibly identify areas for future research by enhancing our current conceptual understanding of the interactions between the various predictor variables.

Structure of the thesis

This thesis is presented in six chapters.

Chapter 1: Introduction

This chapter includes the background information of the chosen topic, my personal context and the purpose of the study.

Chapter 2: Literature review

The context for the study has been set in this chapter by presenting the findings of previous research on the topic. An attempt has been made to categorize findings on academic performance from multiple disciplines for variables such as: age, gender, ethnicity, and level of prior education, place from which prior education was obtained, work experience, prior academic achievement, admission variables, and non-cognitive attributes.

Chapter 3: Methodology

The philosophical basis of the chosen research method has been described in this chapter. The hypotheses have been listed. The methods of data collection and analysis have been elaborated. The proposed statistical tests have been explained.

Chapter 4: Results

The findings of the statistical analyses have been presented. The results of multivariable regression analysis determining the predictive ability of the independent variables has been presented in addition to the findings of the other interpretive and descriptive statistical tests.

Chapter 5: Discussion

The results obtained in this study have been discussed in relation to the findings of other significant published research.

Chapter 6: Conclusion

The summary of the pertinent findings have been emphasized in this chapter. Implications for education practice and future research have been highlighted. Limitations of this research have been acknowledged.

The subsequent section presents the literary references, amidst which this thesis is positioned.

Chapter 2: Literature Review

This chapter offers a comprehensive review of the existing research on the predictors of academic performance in higher education. The predictive ability of variables like: age, gender, ethnicity, level of prior education, place of prior education, work experience and academic achievement on academic performance has been deliberated based on existing published investigations. The hypotheses for the current study have been formulated from the findings of published research that are presented in this chapter.

Programme planners and implementers involved with educating the next generation of oral health practitioners are faced with the challenge of preparing students for the altering population demographics, changing health expectations, developing subject expertise, evolving technologies, and altering practice requirements. The next generation of oral health practitioners have to be competent to meet the requirements of the present population and be future ready for integrated and individualized clinical practice. Students have to be prepared to “apply science-based evidence to clinical practice in a variety of clinical situations” to provide patient-centred care (DePaola, 2008, p. 36).

Science education enables the evaluation of scientific evidence prior to its application. The basic understanding of the scientific basis on which “preventive measures, diagnoses and treatments are carried out” is important (Davies & Warfvinge, 2003, p. 94). Oral Biology and Pathology is a specialized science-related subject that targets to develop an understanding of the development, structure and function of oral tissues in health and disease. It provides a crucial link between foundational sciences and clinical sciences (Scheven, 2012). The biomedical knowledge gained with Oral Biology and Pathology is a critical part of the training. It helps with attaining an “understanding of the underlying mechanism of disease” (Woods, 2007, p. 1175) and provides a scientific basis for clinical decision making and therapeutics. The only empirical way to demonstrate effective teaching and learning at university is by measuring academic performance.

Academic performance has been described as “scholastic standing” of a student at a definite point of time (Sintayehu, 2014, p. 363). It is an output measure of the knowledge, skills and attitude of a student; mostly as a grade. Customarily grades have been regarded as a vital

indicator of academic performance and have been used as criterion in academic research for almost a century (Krumrei-Mancuso, Newton, Kim, & Wilcox, 2013).

Several academic and non-academic factors have been implicated as contributory to academic performance. These include educational, cognitive, psychosocial and demographic variables (Li et al., 2010). Several studies have demonstrated the predictive ability of cognitive and non-cognitive factors in determining academic performance (Ali & Naylor, 2010; Ferguson, James, & Madeley, 2002; Mills & Harmer-Beem, 2008; Platt, Turocy, & McGlumphy, 2001). Accurate prediction and prevention of failure if possible has the potential to utilize resources more effectively (Winston, Van Der Vleuten, & Scherpbier, 2014). If the factors that enable some students to perform well academically can be identified, those factors can be endorsed to help others attain academic success (Abdulghani, Al-drees, Khalil, Ahmad, Ponnaperuma, & Amin, 2014). Likewise identification of impeding factors contributing to failure will enable the implementation of support mechanisms.

The necessity for diversity in all fields of higher education including the health sciences to meet the needs of an increasingly diverse global society has resulted in a cohort of student populations with “pluralities of human identities” (Ghosh, 2012, p. 351). Universities across the Western world have adopted admissions policies to embrace diversity and are attempting to reduce societal disparities by providing equality of access to education (Hoare & Johnston, 2011). The factors that are creating heterogeneity include: age, gender, sexual orientation, ethnicity, race, culture, personality, geographic origin, and language, and socioeconomic status, parental support, learning style, motivation, commitment, prior education, academic achievement and work experience among others. It is essential to elucidate the effectiveness of such inclusive policies on teaching and learning at university. Several studies as detailed in the sections below have used some of these factors as variables to predict academic performance.

Age

The predictive power of age on academic performance has been contentious with some studies favouring school leavers and others favouring mature entrants. A longitudinal study on the academic and non-academic predictors of success in the undergraduate medical course in Nottingham concluded that older or mature entrants were more successful at obtaining a

first class honours grade (James & Chilvers, 2001). The higher success rates among mature students was attributed to the possibility of more familiarity with the demands of undergraduate study. So also a study of nursing and paramedic students in first year bioscience revealed that mature students performed better than students enrolled in the programme straight after finishing school (Whyte, Madigan, & Drinkwater, 2011). Students aged 20 years and over were found to complete their chosen programme earlier than school leavers in a longitudinal study of university students in New Zealand (Tumen et al., 2008). A study of students enrolled to obtain a diploma in higher education found that unqualified students over 22 years of age outperformed unqualified students aged between 17 and 21 (Houltram, 1996). The success of mature students has been attributed to “broader pre-entry training and life experience” that enables them to make a more informed career choice (Wilkinson, Wells, & Bushnell, 2004, p. 1142) and the prior experience of tertiary education in the case of some students. When the data of 222 nursing students was analysed, students more than 34 years of age were found to perform better than the cohort of non-mature students who were less than 20 years old even though they did not have any type of domain specific prior qualifications (Ofori, 2000). The success of mature students has been attributed to higher education being a self –initiated event to achieve some personal goals, superior approaches to learning and academic persistence & perseverance (Richardson, 1994). In fact deferred entry into university, may have equipped mature entrants with self-sufficiency and self-determination, both these attributes contribute to self-regulated learning, a vital requirement at university level (Martin, Wilson, Liem, & Ginns, 2013).

A detailed analysis of the impact of age on grade point average in a study of 542 college students from diverse populations highlighted the complexity of the relationship. Age had a positive and robust correlation with grade point averages that were above the mean but not with grade point averages that were below the mean (Cubeta, Travers, & Sheckley, 2001).

A study on dental school students in Korea revealed that age did not bear any relationship to student achievement (Kim & Lee, 2007). So also a study on academic performance in online courses did not demonstrate an age bias despite expecting a technological disadvantage for older students (Jost, Rude-Parkins, & Githens, 2012). When the level of prior education was controlled, the academic performance of mature occupational therapy students was not significantly different from that of the younger age groups (Shanahan, 2004).

An investigation at Bocconi University in Italy on academic performance among university students of different ages revealed that relatively younger students performed better than the older students (Pellizzari, & Billari, 2012). In economics, a difference of 1.5% to 3.8% in academic performance was noted for each eleven months of age in favour of the younger students. The authors have attributed the better performance to younger students having less active social lives and therefore assigning more time for studies. Likewise in a study of 432 university students in Northwest England, relatively younger students had obtained more first class honours degrees than relatively older students and the plausible explanation given by the authors is that the relatively younger students may have devoted more time for studies (Roberts & Stott, 2015). So also in a study on the academic predictors of success in a three year Pharmacy course, younger student age was a predictor of better academic performance (Unni, Zhang, Radhakrishnan, Smith, Bridgen, DeYoung, & Metzger, 2011).

A retrospective study of 526 accounting students in 1990 found that younger students had performed better in the accounting degree programme (Koh & Koh, 1999). The authors have concluded that any attempt to explain the impact of age on performance can only be speculative. Despite contrary findings, the same conclusion was drawn in a study of nursing students in Pakistan. No correlation was found between age and academic performance (Ali & Naylor, 2010).

Gender

Differences in academic achievement between male students and female students have been inconclusive with some studies reporting one sex to be better academic performers than the other.

A study on Jordanian dental students has reported female students as better academic performers owing to their ability to work hard and sincerely attend classes (Sawair, Baqain, Al-Omari, Wahab, & Rajab, 2009). A higher level of language proficiency has been attributed to the better performance of female dental students at the University of Peradeniya in Sri Lanka (Ariyasinghe & Pallegama, 2013). A study on the academic grades of Korean University students learning English reported that female students scored higher grades despite experiencing higher levels of anxiety and this was attributed to higher motivational levels (Park & French, 2013). A study of 76 international students studying in the United

States revealed that Korean female students showed a higher level of adjustment to the predominant culture than their male counterparts which may have served as an advantage for better academic performance (Lee, Park, & Kim, 2009).

A Pakistani study with 300 students identified female students as better academic achievers due to their ability to adopt better study strategies (Fazal, Hussain, Majoka, & Masood, 2012). Better time management skills was considered a modest predictor of academic success in female psychology students in a study at Keele University (Trueman & Hartley, 1996).

In a study of the academic achievements of students enrolled into the Bachelor of Oral Health programme at the University of Adelaide, both univariate and multivariate analyses models did not demonstrate any significance for gender either in the cognitive or in the clinical components (Gardner, & Roberts-Thomson, 2012). The hypothesis on gender gaps in high stake examinations prompted the study on gender differences in dental licensure examination performance and mock board clinical examination performance at the University of Florida. Stepwise regression analysis demonstrated that the difference between genders was not statistically significant (Stewart, Bates, Smith, & Young, 2006).

Despite chiropractic male students having a higher matriculation grade point average when compared to female students, first year grade point averages in the chiropractic school did not show a statistically significant difference between the two genders (Green, Johnson, & McCarthy, 2003). Gender did not have any predictive utility in explaining academic performance of post graduate business students at Auburn University coercing the authors to conclude that admission decisions into these courses should not be based on gender (Yang & Lu, 2001).

In another study on the impact of gender on high-stakes dental evaluations, men outscored women in the National Board Dental Examination, though women scored higher in biology, reading and comprehension. It was suspected that this difference might have been due to women's tendency to deliberate thoroughly before problem solving at the cost of speed (Fields, Fields, & Beck, 2003). A prospective study to identify factors determining student success in the Medical University of Vienna concluded that 'male sex' was one of the three factors in determining student success (Frischenschlager, Haidinger, & Mitterauer, 2005). In a study of first year prehospital care students, the male sex outperformed the female sex and

this was attributed not to a lack of academic ability among female students but to possibly other non-academic contributory factors (Madigan, 2006). The authors have concluded that the quantitative nature of the study has not been able to capture the contributory factors.

When both gender and age were considered, mature female students had a higher grade point average for the final degree and dissertation in a study of university students in the northeast of the United Kingdom (Sheard, 2009). This quantitative study also found females to have a higher mean score for hardiness and commitment.

The difference between the performances of men and women have been attributed to the varying influence of motivational and academic factors. Higher clinical scores in women has been predicted by variables that determine service while variables like intellectual growth predicted higher clinical scores in men (Ferguson et al., 2002).

Gender was found to moderate the relationship between personality and academic performance in a study of 368 undergraduate management students. Emotional stability was a statistically significant predictor of the positive performance in male students but not in female students (Nguyen, Allen, & Fraccastoro, 2005).

Kidder (2000) in his analysis of gender differences in law school admissions and performance has put forth the following factors as possible reasons: stereotype threat, differential speeds, aversion to risk taking, test bias, fear of success, test anxiety and other personal characteristics.

Most of the studies have considered the ‘declared gender’ from their respective databases as a variable for predicting academic performance. None of the above studies that have focused on gender identity or constructed gender as a predictor of academic performance.

Ethnicity

To reduce health inequality universities are focusing on providing opportunities to candidates from diverse ethnicities but the impact of whether belonging to a minor ethnicity affects academic performance is unclear. When the performance of first year medical students enrolled at the Newcastle University in Australia was investigated using ethnicity as a predictor variable, the statistical results indicated that the performance of aboriginal students was three times more likely to be ‘less satisfactory’ than all other students combined (Kay-

Lambkin, Pearson, & Rolfe, 2002). When the performance of medical students at Monash University was analysed there were significant differences in performance, with students of non-western ethnic background performing consistently poorer in all the final year assessment parameters (Liddell & Koritsas, 2004). Some explanations to the underperformance of ethnic minority students have been: cultural differences, communication barriers, increased anxiety, subjective grading, lower academic entry criteria (Stegers-Jager, Steyerberg, Cohen-Schotanus, & Themmen, 2012). For example, a study of over two thousand graduate and undergraduate students from 10 universities in the US showed a correlation between academic grades and Test of English as a Foreign Language (TOEFL) scores (Cho, & Bridgeman, 2012). Language proficiency has been considered important in academic performance and students with higher proficiency in English had attained significantly better grades (Lucas, Lenstrup, Prinz, Williamson, Yip, & Tipoe, 1997). Despite there being no differences in time management, priorities and goals; ethnic majority students scored higher grades than ethnic minority students in a quantitative study of first year business students attending a university in the western part of the Netherlands (Meeuwisse, Born, & Severiens, 2013).

A qualitative study on ethnic minority medical students with the purpose of exploring obstacles to and opportunities for professional success revealed the following obstacles: racial stereotyping, discrimination in their interactions with peers and faculty, lack of minority role models, financial burden, problems with self-efficacy, challenges with standardized tests, and self-imposed barriers (Odom, Roberts, Johnson, & Cooper, 2007). An analysis of the data of four thousand students in twenty eight colleges and universities demonstrated a significant relationship between the students' perception of racial campus climate and their cumulative grade point averages and on the likelihood of graduating on time. The likelihood of graduating in time increased by 19% with every unit increase in campus climate satisfaction (Fischer, 2010).

In contrast, Asian American university students have been "portrayed as extraordinary achievers" despite facing the same prejudice and discrimination as other ethnic minorities (Stanley & Sumie, 1990, p. 913). When eighth graders were compared, Asian Americans had higher scores than their white counterparts in reading and mathematics (Kao, 1995). Asian Americans have been shown to continue to excel in competitive exams and are not only over

represented among winners of various scholarships and awards but also at prestigious American universities and enjoy three to five times their proportionate share in professions that include doctors, lawyers, engineers, architects and teachers (Zhao & Qiu, 2009).

However a study on the interaction of demographic variables including ethnicity on academic performance in a two year online course delivered by two institutions in Kentucky did not demonstrate ethnicity to be a significant variable when previous academic performance was controlled, signifying that academically able students will perform well regardless of their ethnicity (Jost et al., 2012). Similarly, linear regression analysis for the outcome variables of academic and workplace assessments for undergraduate medical students in the fifth and sixth year using a full range of predictor variables including ethnicity was performed. Ethnicity was not demonstrable as a statistically significant predictor for either of the outcome variables tested (Carr, Celenza, Puddey, & Lake, 2014). Likewise in a study of university students in New Zealand, when tertiary and high school achievements, intensity of study and other background variables were controlled for, the likelihood for completion did not differ among the various ethnicities (Tumen et al., 2008).

One study that has looked at the intersection of race and gender on academic performance has concluded that race and gender had moderated the effects of high school grades and scholastic aptitude scores on college grades (Hogrebe, Ervin, Dwinell, & Newman, 1983). A study such as this has emphasized the need to focus not only on looking at the broader influence of individual variables but also at the intersection of variables. This suggestion of having to consider the interrelation between variables has been highlighted in a study comparing international business students with domestic business students in the Netherlands. The academic performance of these students at the end of the first year of study was primarily determined by the extent to which the students had integrated academically and not by the ethnicity (Rienties, Beausaert, Grohnert, Niemantsverdriet, & Kommers, 2012). Similarly ethnicity was not a factor that had predictive powers when student achievement and study experiences were controlled in a New Zealand study with over seven thousand undergraduate students (Tumen et al., 2008).

Level of Prior Education

Universities have extended admission requirements to reflect their mission of promoting equality of access by opening doors to the traditional cohort of young school leavers and older entrants, some of whom may have prior tertiary qualifications. However, there has been little agreement on whether or not such decisions have an impact on the academic performance of students.

When the student characteristics of one hundred and ninety two chiropractic students were analysed, students already possessing a degree had higher grade point averages at the end of their first year of study (Green et al., 2003). Similarly, a large scale study of graduate entry and school leaver medical students revealed that graduate entry students performed as well as school leaver students in phase I examination but a greater number of graduate entry students passed in the final examination, despite being in an accelerated four year programme (Shehmar, Haldane, Price-Forbes, Macdougall, Fraser, Peterson, & Peile, 2010).

A library based study has revealed that graduates make use of library facilities more than school leavers (Martin, 2003). A number of other reasons have also been put forth as explanations: prior tertiary education experience, clearer motivation, interpersonal skills, developed learning style, confidence, self-directed learning, and better learning approaches for learning progression (Shehmar et al., 2010). However there has been less consensus on whether these advantages are attributable to the prior tertiary qualifications or to age raising questions on whether the admission criteria should consider applicants with prior tertiary qualifications or applicants with life experiences.

In contrast to other studies that have found graduate entry students performing significantly better, a study on the demographic background and prior academic achievement of individual students entering the University of Newcastle Medical School between 1978 and 1989 did not reveal any correlation between academic outcome and level of prior academic achievement within the top 10% achievement band studied (Neame, Powis, & Bristow, 1992). So also, a study from New South Wales showed no difference between school leaving entrants and graduate entrants for academic performance, research outcomes or for career positions obtained after qualifying (Rolfe, Ringland, & Pearson, 2004). The authors also

found that there were no differences in the levels of the motivation for doing medicine between the two groups.

A Queensland university study of medical students from 1972 -1989 found that mature age entrants despite prior tertiary qualifications won less undergraduate honours grades/prizes (Harth, Biggs, & Thong, 1990).

Inconclusive evidence from the various studies have highlighted that policy makers on university admissions have no reason to favour graduate entrants over school leavers or vice versa.

Migrant and International Student Status

Globalization has resulted in increased human mobility and universities today are catering to migrants and international students. Migrants and international students are faced with the challenge of adapting to the predominant culture. They are faced with the task of socializing linguistically, socially and academically (Simpson, & Cooke, 2009). The psychological impact of adapting to a different culture and living in a foreign country can complicate the lives of migrant students and international students (Huijskens, Hoosharian, Scherpbier, & Van Der Horst, 2010). Teaching and learning practices in Western universities may not always consider the cultural differences that international and migrant students' experience. For example a migrant student unexposed to student-centred learning may find self-directed learning and problem-based learning used in Western universities challenging (Frambach, Driessen, Chan, & van der Vleuten, 2012).

A study using multivariate regression analysis to analyse the academic performance of final year dental students at the University of Otago demonstrated that the best predictor of higher class placement in the final year was New Zealand European ethnicity and domestic rather than international student status (Rich, Ayers, Thomson, Sinclair, Rohan, & Seymour, 2012). The authors have concluded that English being the second language for many international students might have been contributory to their lower academic performance. Students with lower proficiency in English fail to adequately participate in collaborative activities like case discussions (Ranasinghe, Ellawela, & Gunatilake, 2012). So also communication with teachers, patients and fellow students might possibly be hindered. A study of university students in the United Kingdom that compared Chinese students with other international

students found that the English writing ability was a significant predictor of academic success for all international students (Li et al., 2010).

Students whose place of residence was closer to the university i.e. students from Northern Europe performed better at the Middlesex Business school in the United Kingdom than their counterparts from Southern Europe and from other parts of the world (Chansarkar, & Michaeloudis, 2001). In contrast, a study at Curtin University of Technology in Western Australia found that overseas students outperformed the local students and also had lower dropout rates (Pauley, 1988 as cited in Morrison, Merrick, Higgs, & Metais, 2005). Similarly a study of Singaporean students enrolled in engineering at the University of Surrey were found to perform better than their British peers (Marshall, 1995).

Migrant and international students are mostly from ethnic minorities. A study on ethnic minority students has found that these students did not view the educational environment as a source of support and guidance (Raval, gan, Hosseinzadeh, Yaghoub-Zadeh, Molnar, Hamlin, Vrazic, 2008). Factors like these influence the perception of campus climate by students. An analysis of the data of four thousand students in twenty eight colleges and universities in the United States demonstrated a significant relationship between the students' perception of campus climate and their cumulative grade point averages (Fischer, 2010). In contrast, despite higher satisfaction with overall campus experience, international and exchange Pharmacy students performed less well than local students in an Australian study (Davey, Grant, & Anoopkumar-Dukie, 2013).

Students of immigrant parents in North America achieved higher levels of education than those whose parents were born locally which is in contrast to what has been seen in Europe. This prompted a longitudinal study on immigrant backgrounds in Canada and Switzerland but the study was concluded with more questions than answers and suggestions for future research (Picot & Hou, 2013).

Studies on the academic achievement of migrant and international students' show a very mixed picture which may be attributed to the fact that international students and students from migrant communities are not a homogenous group in terms of level of prior education, academic ability and exposure, or English language skills. International students have differing needs based on their country of origin, level of tertiary experience, prior academic

achievement and gender (Hanassab & Tidwell, 2002). Studies that are more sophisticated in design may throw light on explaining the differences.

Prior Academic Achievement

Universities have considered prior academic achievement as a selection criteria to increase the possibility of the selected candidates to not only successfully complete the course but to also positively contribute to the profession and society (Lynch, McConnell, & Hannigan, 2006).

A thirty year retrospective study of medical students in Croatia found that the variable of high school grades was a significant predictor ($r=0.27$, $p<0.01$) for graduating grades (Maslov et al., 2012). This finding is similar to the finding in a study of seven hundred business studies students in Kuwait; high school grade point average was a significant predictor for the students' academic performance in the business college (Nout & Aishah, 2014). These findings have had prior endorsement with a previous study of black accounting students that found that the college performance of the students had a positive association ($p<0.05$) with their academic performance in accounting courses at university (Gist, Goedde, & Ward, 1996).

A six year review of dental hygiene students in Georgia has also highlighted the ability of college grade point average to predict the graduating grade point average in the dental hygiene course and the authors have endorsed performance based selection of students (Downey, et al., 2002). This finding has been demonstrated again by a study on dental students in the University of Western Australia where prior academic achievement was a significant predictor for the academic performance in each of the five years of study (Mercer, Abbott, & Puddey, 2013).

Tickell and Smyrnios (2005) have specifically demonstrated that the academic performance in a particular discipline is dependent on the academic performance in the same discipline in the previous year. In their study of accounting students at university, they found that successful completion of accounting course at school had an enduring positive effect on the subsequent academic performances at university.

A study on accounting students statistically demonstrated that performance in university examinations is best predicted at statistical significance of 1% by academic achievements in previous university examinations (Bartlett et al., 1993). Likewise a meta-analysis of the relationship between prior academic achievement and subsequent academic achievement at university found prior academic achievement to have the largest effect size ($d=0.67$) among individual level achievement factors (Hattie, 2009). This may be attributed to the similar assessments and outcome measures at university. This finding of earlier university examinations especially the grade point average in the first year being predictive of graduating grade point average was also evident in a retrospective study of dental students at the University of California (Curtis, Lind, Plesh, & Finzen, 2007)

However, in a study of low achieving dental students, college grade point average did not have any correlation to the graduating grade point average (Curtis et al., 2007) and neither did an earlier study on dental students in Ireland find any correlation between school leaving certificate grades and the final dental examination performance (Lynch et al., 2006). Likewise students' achievement in bursary examinations had less predictive power on students' academic performance at a New Zealand university when the completion time was four or five years (Tumen et al., 2008). Similarly school leaving examination grades were not predictive of first year medical school academic performance in a study of 721 medical students in London (Richardson, Winder, Briggs, & Tydeman, 1998). These findings are suggesting the inability of school leaving grades to assess academic potential or ability. Moreover the study strategies used in matriculation may not be as effective at university which has a higher academic demand requiring not only good information processing skills but also higher order cognitive processes like critical thinking (Yip & Chung, 2005).

The ability of the high school grade point average for Hispanics and Black students has been found to be not as reliable as for Asian and White students in predicting college grade point averages. Latinos and Black students' achievement is lower at college despite having high school grades that are similar to their White and Asian counterparts (Miller, 2005). Secondary school grades are not reliably predictive of the academic performance of mature students and female students with the same secondary school grades as their male counterparts outperform their male counterparts (McKenzie & Schweitzer, 2001). The predictive capacity of prior

academic achievement like high school grades is different for different groups and individuals and hence its reliability as a universal predictor is questionable.

Prior Work Experience

Universities have also opted to considering relevant work experience while admitting candidates into courses. However studies on the predicting role of relevant work experience on academic performance have yielded mixed results.

Malstrom, Klecka and Shell (1984) in their study of engineering students found that prior work experience was a significant predictor of student success (as cited by Grudnitski, 1997). A longitudinal study with a sample of 324 management students in India found that there was a positive relationship between prior job experience and academic performance in the management course (Uppal & Mishra, 2014). The better academic performance has been attributed to the experiential background that may help students make better sense of the concepts (Uppal & Mishra, 2014).

The positive regression coefficients for previous work experience obtained in a retrospective study on the determinants of academic performance of 526 accounting students have compelled the authors to recommend the introduction of a compulsory work attachment to the accounting degree (Koh & Koh, 1999). The authors have postulated that exposure to working environments may sharpen analytical skills.

In contrast, a study to explore the relationship between work experience and overall academic performance among Pharmacy students with a multivariate model did not demonstrate any correlation (Mar, Barnett, Tang, Sasaki-Hill, Kuperberg, & Knapp, 2010). Similarly, a study on dental students' academic performance revealed statistically insignificant correlations between dental-assisting experience and pre-clinical and clinical assessment grades (Park, Da Silva, Barnes Susarla, & Howell, 2010). Work experience as dental assistants may have not aided with the academic learning at university. In a study of nursing students, health-related work experience had a negative relationship with the clinical grade point average. The authors have suggested that “acquiring clinical experience prior to the theoretical components of the field of study” may have “impeded theoretical learning” (Whyte et al., 2011, p. 853).

Engagement in paid employment during semester terms was found to negatively affect the academic performance of nursing students. In a longitudinal study of nursing students in Australia, there was an inverse relationship between the graduating grade point average and the number of hours in paid employment (Salamonson, Everett, Koch, Andrew, & Davidson, 2012). In contrast, a study of 104 accounting students, holding non-accounting jobs while studying was not significantly correlated with negative academic performance (Maksy & Zheng, 2008).

The conflicting results cited above reveal a complex relationship between academic performance and work experience.

Non Cognitive Factors

Traditionally academic performance has focused on scholastic ability or intelligence without giving due considerations to the coexisting non-cognitive factors that have a bearing on academic accomplishment. Academic achievement is dependent on other individual and communal factors, some of which the students can control and some like campus climate over which they may have little or no control. A study of fourteen thousand community college students in California revealed student performance to be statistically related to satisfaction of campus climate, academic services including teaching, counselling services, responsiveness to diverse populations, student centeredness, safety and security (Michelle, 2011). A study looking at the predictors of academic success in diverse populations that highlighted the role of campus climate by empirically demonstrating that more successful students, unlike their less successful peers perceive their college environments to be acceptable of racial diversity (Cubeta et al., 2001).

While the campus climate is crucial, so also are other individual factors like commitment and conscientiousness. Female students with higher scores for commitment were shown to perform better in a quantitative study done in the UK (Sheard, 2009). A meta-analysis of personality traits and academic performance has concluded conscientiousness to be moderately related to academic performance (O'Connor & Paunonen, 2007). In fact conscientiousness was shown to predict academic performance more reliably than academic ability in an earlier study (Conard, 2006).

Attendance at university has also been shown to have a positive effect on academic performance (Dollinger, Matyja, & Huber, 2008). Jordanian female dental students have been reported as better academic performers owing to their ability to sincerely attend classes (Sawair et al., 2009). Similarly, a study of 135 Pharmacy students identified a negative association between academic performance and absenteeism (Hidayat, Vansal, Kim, Sullivan, & Salbu, 2012)

Motivation, as measured by a students' visualization of their final grade or achievement-striving behaviour was significantly associated with positive academic performance in advanced accounting and auditing courses (Maksy & Zheng, 2008). A study of two hundred and forty three students revealed a positive association ($r=0.24$, $p<0.01$) between emotional intelligence and scholastic outcome (Downey, Lomas, & Stough, 2014). On the other hand neuroticism or psychoticism have been demonstrated as having a negative impact on academic performance in two longitudinal studies of two British university samples (Chamorro-Premuzic & Furnham, 2003). Likewise, stress levels as reported by students and salivary cortisol levels had a negative correlation with academic performance (Ng, Koh, & Chia, 2003).

Socioeconomic status is one of the stress inducing factors. The results of a survey of the College of Engineering's students at the University of Puerto Rico was that 40% the engineering students felt that a low household income negatively affects their college performance (Miguel-Vázquez, Bartolomei-Suárez, & Grey, 2013). Poor socioeconomic background was empirically demonstrated to be a predictor of poor academic outcomes for graduate entry students in a study of medical students enrolled in a Western Australian university between 2005 and 2012 (Puddey & Mercer, 2014).

Focus group discussions with high achieving medical students brought to light the following factors as influencing high academic achievement: attendance to lectures, early revision, prioritization of learning needs, deep learning, learning in small groups, mind mapping, learning from mistakes, family support, learning from patients and time management (Abdulghani et al., 2014).

While certain noble non cognitive factors such as motivation have been universally considered to have a positive association with academic performance (Maksy & Zheng,

2008) , performance measures based on grade point averages or cumulative grade points do not take into consideration the differences between courses and the individualized assessment practices in each of the courses. It is clear that relationships between any of these factors and academic performance should be looked at course levels rather than across courses. These points have been highlighted by a study on students enrolled in an intermediate psychology course. The study time of students enrolled in this study did not correlate with their examination scores (Zuriff, 2003).

Admission Variables

Several quantitative studies using factors influencing admission factors as variables to predict academic performance in higher education including dental education, have been published. A regression model was used in a study of three hundred and ninety eight Australian undergraduate dental students using the following predictor variables: age, gender, scores obtained in the aptitude test, prior academic achievement, and scores obtained in the interview. The outcome variable was the weighted average mark in each of the five academic years. The interview score and previous academic achievement showed a strong correlation with the weighted mark average in the clinical years (Mercer et al., 2013). This finding is similar to the finding that structured interview scores were predictive of academic performance at medical school (Lambe & Bristow, 2011).

The Medical College Admissions Test (MCAT) scores were shown to predict performance in the United States Medical Licensing exams (USMLE). The MCAT scores were predictive of the scores in the USMLE Step 3 exam that was taken six years after MCAT (Ellen, 2005). One reason for the predictive ability of the MCAT scores may have probably been the similar nature of the two high stake exams.

Academic transcripts and admissions documents of a hundred and thirty four students enrolled in the dental hygiene programme at the Medical School of Georgia was subject to multiple linear regression analysis with the following predictor variables: incoming grade point average, incoming maths/science grade point average and scores in the scholastic aptitude test. The outcome variables were: graduating grade point average and dental hygiene national board score. Multiple linear regression analysis revealed that the incoming grade point average was a significant predictor of dental hygiene national board score. Both the

incoming grade point average and the scores in the scholastic aptitude test were predictors of the graduating grade point average (Downey et al., 2002).

A similar study on graduate entry Korean dental students revealed the undergraduate grade point average was a significant predictor and was positively correlated ($r=0.242$, $p<0.01$) with that of the students' first semester achievement (Kim & Lee, 2007). Academic performance depends on both cognitive and non-cognitive predictors. In a quantitative study of over seven hundred Belgian dental students, scores obtained in the situational judgment test that measured interpersonal skills was shown to be a valid predictor for academic performance in the final year of study (Buyse & Lievens, 2011). Not unlike the other studies mentioned above, prior academic achievement especially in Chemistry and interview scores were positively related to academic performance in each of the five years of study of medical students in the UK (Lambe & Bristow, 2011). Statistical tests on the progress of medical students after open admission or admission based on knowledge tests demonstrated convincingly that performance based selection of students raised the probability of student success (Reibnegger, Caluba, Ithaler, Manhal, Neges, & Smolle, 2010).

In a study with four hundred and fifty nine students enrolled in the University of Florida School of Dentistry, multivariate analysis revealed that undergraduate science grade point average and interview scores were the most consistent determinants of dental school grade point average (Sandow, Jones, Peek, Courts, & Watson, 2002). When the variable of dental assisting experience was added with other variables like undergraduate science grade point average, dental admission test score and perceptual ability test score to determine their correlation to the preclinical and clinical assessment scores, the dental assisting experience variable was not significantly correlated. However students with dental assisting experience were more than twice as likely to get an honours as those who did not have any dental assisting experience (Park et al., 2010).

There has been much deliberation on the inclusion of psychometric tests that analyse the ability of the students to process information in critical situations with ethical or moral dilemmas. The Health Sciences Reasoning Test used as a screening test for Pharmacy students at the North Dakota university was useful in determining the critical thinking ability

of candidates but not in conclusively predicting academic performance (Kelsch & Friesner, 2014).

Unlike the above studies, very few educational and demographic variables had a significant impact on final year university examinations of students enrolled in an accounting course, the only significant variable was academic performance in the first year examinations; forcing the authors of the paper to conclude that background characteristics of students at enrolment were less influential on future academic performance (Bartlett et al., 1993). This finding is similar to a study on the impact of admission variables on academic performance at a Saudi Arabian medical school which found that only 6.5% of the variance in medical school performance could be attributed to the admission variables (Al-Rukban, Munshi, Abdulghani, & Al-Hoqail, 2010). Likewise, in a study of predictors for academic performance in first year bioscience using regression analysis, success in bioscience was not attributed to any course specific selection criteria (Whyte et al., 2011).

The dental aptitude test that measured the general cognitive ability of students in a Canadian dental school was predictive of the preclinical performance of students while the scores in the interview component of the selection process was not predictive of student academic performance in the first two years (Smithers, Catano, & Cunningham, 2004). Likewise no relationship was evident empirically between interview scores and overall academic performance in a study of graduate entry medical students at the University of Western Australia (Puddley & Mercer, 2014).

Admission criteria have not always been successful in predicting future academic performance. A meta-analysis of the factors affecting medical school performance concluded that while cognitive measures such as previous academic performance tend to over predict for ethnic minorities but under predict for white students (Ferguson et al., 2002). Using logistic regression analysis, a study of medical students enrolled in the Newcastle University concluded that aboriginal and overseas medical students had academic difficulties in the first year but these difficulties did not persist beyond the first year (Kay-Lambkin et al., 2002).

Admission criteria like college grade point average, science grade point average, academic average and perceptual ability test were shown to be neither correlated to the first year grade point average of dental school students nor with the graduating grade point average in a

retrospective study carried out at the University of California (Curtis et al., 2007). The authors have questioned the appropriateness of admission criteria that were used and have recommended investigating the use of behavioural measures to evaluate applicants. The same suggestion was made following a study of 144 students in Malaysia when no correlation could be demonstrated between academic performance at university and cumulative grade point average at pre-university (Amin, Hanawi, Hazura, Saad, Sahari, & Ibrahim. 2013).

Personality Traits

Some studies have used personality traits as predictors of academic success. A longitudinal study of two British University samples assessed academic performance via multiple criteria including absenteeism & seminar behaviour and concluded that neuroticism impairs academic performance while being conscientious may lead to higher academic achievement (Chamorro-Premuzic & Furnham, 2003). The results have prompted the authors to conclude that personality inventories should not be neglected during academic selection processes.

An empirical investigation using twelve predictor variables including motivational factors to determine academic performance in an intermediate accounting course demonstrated that the self-perceived ability in mathematics was a positive predictor for academic performance. A study that sought to examine fluid intelligence, personality traits and emotional intelligence in predicting academic success concluded that higher levels of emotion management and control, conscientiousness and lower levels of extraversion was associated with academic success (Downey et al., 2014). Conscientiousness is known to change over time but the reasons for the change has no consensus. It has been speculated to be either due to maturation of individuals with age or due to the environmental challenges (Conard, 2006). Cheerful and optimistic students were found to perform better in the clinical training of dental students in a Canadian Dental School (Smithers et al., 2004). In contrast, a study on business students unexpectedly found that confidence levels were not predictive of academic performance but feelings of inferiority and academic striving were predictive of academic performance (Nonis, Hudson, Philhours, & Teng, 2005).

Using the overall grade point average of a hundred and twelve baccalaureate nursing students as the outcome variable, and eight non-cognitive variables as predictor variables, multivariate analysis revealed that realistic self-appraisal and understanding racism were the only two

variables that were significantly correlated to academic performance as measured by the grade point average (Kornguth, Frisch, Shovein, & Williams, 1994).

Poole, Catano and Cunningham (2007) found through the data gathered from structured interviews that students' 'conscientiousness' was positively correlated with academic and clinical performance in all four dental school years.

An analysis of study strategies of over two hundred students enrolled in the Chinese University at Hong Kong using variables like attitude, concentration, information processing, and self-testing among others; concluded that study strategies were consistent determinants of academic performance (Yip & Chung, 2005).

Research on whether diligent students who invest in more study time on one hundred and sixty eight students at Hasselt University concluded that for most courses study time predicts grades, though not for all courses (Masui, Broeckmans, Doumen, Groenen, & Molenberghs, 2014).

The role of ethnicity and the ability to integrate academically and socially and academic performance in international business students in the Netherlands was analysed. Academic integration was found to be the most predictive variable of academic performance (Rienties et al., 2012).

Self-efficacy was a significant predictor of academic performance in an analysis that also included other cognitive, demographic and psychosocial predictors of academic success in first year Australian university students (McKenzie & Schweitzer, 2001).

Anxiety has been put forth as a factor influencing acquisition of second language skills and several studies have demonstrated anxiety levels to be a crucial variable in learning a second language. High anxiety students were shown to obtain higher grades than students with low anxiety scores in a study of Korean students enrolled in an English class (Park & French, 2013).

A study of 280 German high school students found that school performance was better predicted by personality variables like self-concept, motivation, anxiety, learning, working

and cognitive styles. In fact the predictive ability of school performance with the personality variables was better than with psychometric tests (Rindermann & Neubauer, 2001).

In contrast to the above mentioned studies, a study of over thousand students enrolled in the Faculty of Social Sciences at the University of Tartu failed to demonstrate any correlation between personality traits such as neuroticism, extraversion, openness to experience, conscientiousness & agreeableness and academic performance (Allik & Realo, 1997). The authors have cautiously concluded that the failure to demonstrate a correlation statistically does not indicate that there is no interrelation between the two realms. However an earlier study on Canadian dental students that used both narrow and broad personality measures found that though some of the broader measures like extroversion and neuroticism did not predict academic performance, narrower measures like openness to ideas and positive emotions did improve the prediction of performance in clinical studies (Smithers et al., 2004).

The conclusions from the above cited studies not only highlight the importance of study design but also the contextual nature of the conclusions drawn.

Research Methodologies used in Predictive Studies

Most of the studies that set out to identify predictors of academic performance have used prospective (Tumen et al., 2008) or retrospective quantitative methods (Bartlett et al., 1993; Downey et al., 2014; Shehmar et al., 2010) with some being longitudinal (Bartlett et al., 1993; Shehmar et al., 2010; Tumen et al., 2008) and most being cross-sectional (Downey et al., 2014; Kay-Lambkin et al., 2002; Sheard, 2009; Whyte et al., 2011; Wong & Wong, 1999).

The methods of data collection have included obtaining data from the university data bases (Bartlett et al., 1993; Shehmar et al., 2010) or through voluntary student surveys (Miguel-Vázquez et al., 2013). Park & French, 2013). However some studies have obtained some data from data bases and other data through student surveys (Masu et al., 2014; Tumen et al., 2008).

Multiple regression analyses has been used by many of the studies (Bartlett et al., 1993; Downey et al., 2014; Sheard, 2009; Tumen et al., 2008; Wong & Wong, 1999), analysis of variance has been used by a few (Jost et al., 2012; Park & French, 2013; Shehmar et al., 2010; Whyte et al., 2011), independent sample t tests have been used to establish differences between groups (Li et al., 2010) and some studies have used univariate analysis either as a

standalone statistical test (Richardson, 2006) or in conjunction with the multivariate analysis (Gardner, & Roberts-Thomson, 2012).

While the number of qualitative studies remain limited, the study by Abdulghani et al. in 2014 which obtained data through focus group sessions offered understandings on factors determining academic achievement in high achieving medical students.

Though each of the research approaches employed by the various studies have certain robust attributes about them, there are limitations. While obtaining data through data bases ensures minimal missing data and better sample sizes for running statistical tests, it has a limited scope and student perspectives are not taken into account. Qualitative studies not only limit the possibility of using very large samples but are also more subjective than objective.

Purpose of Predictive Studies

The purpose of these studies have been varied. While some studies have been done with the purpose of checking if admission practices are justified and if they bring in the best cohort of students (Ariyasinghe, & Pallegama, 2013; Buyse, & Lievens, 2011; Curtis et al., 2007; Downey et al., 2002; Harth et al., 1990; Kay-Lambkin et al., 2002). Other studies have focused on determining what support mechanisms can be put in place to eliminate disparities in student performance (Winston et al., 2014). Though prior academic achievement has been demonstrated repeatedly by multiple studies (Downey et al., 2002; Kim & Lee, 2007; Mercer et al., 2013) to predict academic performance, previous academic performance may underestimate the true capacity of some individual students. Support programmes like the pre-matriculation learning programme that engaged low scoring students, prepared students for medical school (Lindner, Sacks, Sheakley, Seidel, Wahlig, Rojas, & Coleman, 2013). Academic performance of students who had enrolled in the pre-matriculation learning programme was not significantly different from those of the other students as compared by the USMLE (United States Medical Licensing Examination) step 1 grades (Lindner et al., 2013). Prediction of poor academic performance helps with remediation to prevent failure. Small group sessions for students who had performed poorly at a US medical school in the Caribbean improved pass rates (Winston et al., 2014). The results of such studies will enable universities to formulate and adapt policies to cater to diverse student populations. Such

initiatives will go one step further is assuring that all students have an equal chance at academic success (McKenzie & Schweitzer, 2001).

Relevance of Oral Biology and Pathology

Oral Biology and Pathology is a knowledge based full year compulsory paper for second year students enrolled in the Bachelor of Oral Health programme at the Auckland University of Technology. The paper covers anatomy, physiology, histology and embryology of the head & neck and also oral Microbiology and Pathology. The prerequisite paper (Human Anatomy and Physiology II) would have introduced the fundamental concepts of anatomy, physiology, embryology, microbiology, pathology and pharmacology. Some of the applied aspects of the basic concepts would also have been introduced in the prerequisite paper. The Oral Biology and Pathology paper integrates horizontally and vertically with the other preclinical, para clinical and clinical papers in the Bachelor of Health Science (Oral Health) course by linking the biological principles to the technical skills that students learn in the other papers. The biomedical knowledge obtained with the Oral Biology and Pathology paper is a “critical variable for the construction of a coherent base of clinical knowledge” (Schauber, Hecht, Nouns, & Dettmer, 2013 p. 1231). Applying clinical information successfully to cases that present with disorganized clinical features is only possible when students have appropriate biomedical knowledge (Woods, 2007). The bearing of this subject on clinical practice is well understood as the knowledge gained from basic sciences provides the scientific underpinning for clinical practice (Wong, & Wong, 1999).

A questionnaire based survey on the relevance of Oral Biology was carried out on 60 students and interns of a Pakistani dental college. The relevance of this subject to dentistry was reported as high by students and interns. Interns, who are mostly more engaged in clinical practice than students, reported higher relevance than students (Farooq & Ali, 2014).

When the correlation between grade point average for the basic sciences and the cumulative graduating grade point average for two hundred and fifty eight nursing students was calculated, it was found to be statistically significant, providing evidence of the contribution that basic sciences including pathophysiology make to final academic success (Wong & Wong, 1999).

A study on the impact of basic anatomy performance on licensure medical exams has recommended using performance of early years of medical school to identify medical students at risk for failure (Peterson & Tucker, 2005).

The role of basic sciences in education includes: “development of clinical reasoning”, “critical analysis of medical and surgical intervention”, and “analysis of processes to improve health care” (Grande, 2009, p.802) and performance in bioscience subjects is a powerful predictor of subsequent academic success (Peterson & Tucker, 2005; Whyte et al., 2011; Wong & Wong, 1999).

Considering the potentially long term impact that academic performance in a bioscience subject like Oral Biology and Pathology has, it is necessary to identify the factors that predict academic performance so that the impediments of success can be identified and dealt with.

Key Issues

It is clearly evident from the literature discussed that the predictive ability of the variables used in various studies is inconsistent and differs from programme to programme. In fact the correlation between academic performance and some of the variables have been proven to be contradictory by different studies, possibly due to their contextual nature. The literature on the predictability of student success has been uninspiring in its ability to reach an accord. The results obtained from any one study cannot be generalized or applied to a different cohort of students studying an entirely different course at a dissimilar university. Though it is clearly evident from the literature review that the academic performance in a bioscience subject is predictive of the final grade point average and success in licensure examinations, there is no published literature using academic performance in a discipline specific bioscience paper like the Oral Biology and Pathology paper as an outcome variable. Much of the research till now has mostly focused on predicting the academic performance of students in their first year at university or on the grade point average for the course. The purpose of this retrospective study is to investigate the ability of a selected set of variables to predict the academic performance of students enrolled in the Oral Biology and Pathology paper.

Chapter 3: Methodology

This chapter outlines the research framework, the hypotheses, the methods of data collection and the statistical tests used. A literature review on the topic of predictors of academic performance has augmented my rationale for doing this study by clearly highlighting that academic performance is not only multifactorial but also context specific; making it unassailable for the results from one discipline to be applied to another. The purpose of this study was to determine the:

- Relationship between a set of predictor variables and the academic performance in the Oral Biology and Pathology paper
- Extent to which each of the selected variables predict the academic performance in the Oral Biology and Pathology paper

Study Variables

The outcome or dependent variable was the grade obtained in the Oral biology and Pathology paper. The grades were: A+, A, A-, B+, B, B-, C+, C, C- and D. The grades were calculated from the grades obtained in each of the assessed learning outcomes in the paper. The assessments included two written examinations and an oral presentation to assess the seven learning outcomes. The predictor or independent variables were: age, sex, ethnicity, level of prior education, place from where prior education was obtained, work experience, and grade obtained in the pre-requisite paper. The predictor variables chosen included demographic and experiential attributes that could not only be retrieved from the database but also be applied consistently across the sample. The predictor variable for prior academic achievement that could be consistently applied to the whole sample was the grade in the prerequisite paper and hence that was included.

Table 1

List Of Variables

Outcome or Dependent Variable	Predictor or Independent Variable
Grade obtained in the Oral Biology and Pathology paper	Age Gender Ethnicity Level of Prior Education Place of Prior Education Work Experience Grade obtained in the prerequisite paper

Study Hypotheses

Four hypotheses were generated from the vast landscape of literature when the objectives of the study were synchronized. The purpose of this retrospective research is to objectively demonstrate performance predictors in the Oral Biology and Pathology paper and test the following hypotheses:

- There is no relationship between factors such as age, gender, and ethnicity of the student and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between the level of prior education (in New Zealand or elsewhere) and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between work experience and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between the score in the prerequisite paper and academic success in the ‘Oral Biology and Pathology’ paper.

Research Approach

Though this study appears to be based on a deterministic philosophy, the literature review has amplified my philosophical belief that the “world is ambiguous, variable and multiple in

its realities” and what might be applicable to one set of data in a particular context may not be to another (O'Leary, 2004, p. 6). The ontological basis of this research is the assumption that reality “is objective in the sense that it reflects an intersubjective reality” (Weber, 2004, p. v), in that the factual data that has been obtained for this study and the contextual background is understood by people with shared interests. The ontological foundation is realism as the data obtained for this research exists independent of me, the researcher. The data has been quantified and shared through language given that “language is shared by a collective” (Darlaston-Jones, 2007, p. 25). The epistemological basis is post positivism. Though the data is concrete, it has been drawn from mutable situations to predict academic performance in the Oral Biology and Pathology paper; with an understanding that academic performance is individual, contextual and multifactorial; and there are other variables, some that are known and some that are unknown, that have not been considered in this study. So also the data has been subjected to “inferential statistical analysis that cannot be taken at face-value” (Scotland, 2012, p.11); while still being valuable in determining if the selected variables of the group “manifest certain kinds of regularities” (Weber, 2004, p. vii). The statistical analysis has enabled “complex aspects of human beings researchable”; to seek “prediction and explanation” (Clark, 1998, p. 1247).

The methodology used here is: theory verification. The extensive literature review has theoretically revealed that academic predictors are “exhaustively analysable to generate some terminating judgments” based on one objective belief but may not be applicable to any other sets of objective beliefs. (Nelson, 1954, p. 185). It has generated the possibility of varied propositions based on the variables that have been considered. The set of ideas from the literature review, some of which have been used to guide admission procedures in higher education has generated four hypotheses from the “interrelated set of constructs” postulating a “relationship among the variables” (Creswell, 1994, p.82). The data has been statistically analysed to test them using the hypothetico-deductive approach; according to which information can be generated deductively from a hypothesis to claim objectivity for the results obtained with the data used by obtaining some definite associations between the data collected and the hypotheses (Mack, 2012).

The research method for this retrospective study is the quantitative method. The research design was non-experimental, ex post facto because the data variables were examined after their occurrence. Desensitized data was obtained for this research.

Data Collection

The secondary data was obtained from electronic records stored in the University's computerized data base. The data custodian released desensitized data to maintain anonymity of the students. The desensitized data thus obtained has ensured data protection by making no person identifiable to carry out analysis about any single person and therefore unlikely to have impacted on any single person's rights (Grant, 2009), while still making information available for the purposes of research. The findings of which could influence policy. The data collected was over a period of four years, making it impossible to identify students from the data and thereby completely eliminating the possibility of any potential conflict of interest between me and the students. The data was categorized into variables.

Sample

The sample for this study was a purposive sample of all students who had enrolled in the Oral Biology and Pathology paper at Auckland University of Technology over a four year period from 2011 to 2014. The total sample consisted of 118 students. Data of two students was not used for statistical analysis. One student did not complete, one student withdrew and cases with missing dependent or outcome variables are typically deleted (McKnight, 2007). Three students were credited for the pre-requisite paper and hence prior academic achievement could not be measured in these three students. The sample was restricted to these four years as the faculty, curriculum, teaching methods and assessments including the grading criteria, during the period was more or less similar.

Statistics

The objective of the statistical analysis was to predict the dependent or outcome variable using the predictor or independent variables. Two inferential statistical tests that were used for analyses: Pearson's correlation coefficient and multivariable regression analysis.

Pearson's correlation co-efficient was calculated between the grades obtained in the Oral Biology and Pathology paper and each of the predictor variables. The correlation coefficient (r) was calculated to determine the strength of the relationship between the outcome variable

and each of the predictor variables (Bernard, 2013). The level of significance was established at 0.05.

Multivariable regressive analysis lends itself for the purpose of predicting the outcome variable with a set of predictor or independent variables (Yockey, 2011). The multivariable regression analysis was applied to the final grade in the 'Oral Biology and Pathology' paper (outcome/dependent variable) and the full set of predictor/independent variables (age, sex, ethnicity, level of prior education, place of prior education, work experience, grade obtained in the pre-requisite paper) to determine the degree to which the predictor variables accounted for the outcome variable. The multiple correlation (R) was calculated to indicate the strength of the relationship between the predictor variables and the outcome variable while also considering the possibility that each independent/predictor variable may be correlated to other independent/predictor variables (Bernard, 2013). The coefficient of multiple determination (R^2) was calculated to determine the amount of variance in the outcome variable that could be accounted for by the predictor variables (Bernard, 2013). The level of significance for the multivariable regression analysis was established at 0.05.

The Chi-square test was considered to test the hypotheses with the nominal variables: age, sex, gender, level of prior education, place from which prior education was obtained, work experience. Though the Chi-square test is a non-parametric test that is suitable to determine any differences in the relationship between the nominal predictor variables and the outcome variable, it could not be applied to our set of data as it did not fulfil the criteria of there being no more than 20% of the categories with frequencies of less than five (McHugh, 2013).

In addition, the one sample t test will be used to compare the means of the scores obtained in the Oral Biology and Pathology paper with that of the means of the scores obtained in the prerequisite paper.

The data analysis also included generating descriptive statistics: frequencies, percentages, ranges, means & standard deviation, as appropriate.

The raw de-identified data was entered into IBM SPSS (Statistical Package for Social Sciences) version 22 for windows. SPSS (version 22) is a powerful statistical package offering a range of statistical approaches with comprehensive data management tools. Data

can be entered and effectively organized into categories for comparison. Data can be easily recoded for analysis. The data base created was relational in the sense that one set of numbers can be related statistically to another set of numbers (Watson, 2003). The package offered a lot of choices for data analysis. The analysed data could be obtained in the form of tables and graphs in a relatively very short timeframe. The output data was kept separate from the data sheet thus eliminating the risk of overwriting information, while still allowing exportation of output data to word and excel.

The variables were recoded into numerical values to render them suitable for statistical analysis. The grades in the Oral Biology and Pathology paper, the grades in the prerequisite paper and ethnicity were treated as nominal variables while gender, level of prior education, work experience and place of prior education were treated as categorical variables. Each grade was assigned the middle number of the numerical range used at the Auckland University of Technology. The numerical value for D grade was designated as 48. The variables were re- coded in SPSS as below:

Table 2

Recoding of Variables

Variable	Categories of each variable	Re-coded number in SPSS
Grade obtained in Oral Biology and Pathology	A+	95
	A	88
	A-	83
	B+	78
	B	73
	B-	68
	C+	63
	C	58
	C-	53
	D	48
Gender	Male	1
	Female	2

Table 2 (cont'd)

Recoding of Variables

Variable	Categories of each variable	Re-coded number in SPSS
Ethnicity	Other	1
	Pasifika	2
	Maori	3
	Asian	4
	European	5
	Non declared	9999
Level of Prior Education	Secondary	1
	Tertiary	2
Work Experience	No	1
	Yes	2
Place of Prior Education	Overseas	1
	New Zealand	2
Grade obtained in the prerequisite paper	A+	95
	A	88
	A-	83
	B+	78
	B	73
	B-	68
	C+	63
	C	58
	C-	53
	D	48
	Credited	99999

Ethics

Desensitized data was provided by the data custodian for the purpose of this research. It was confirmed by AUTECH (Auckland University of Technology Ethics Committee) that ethics approval was not required for this research.

Validity

Internal and external validity has not been established for this study. The contextual nature of this retrospective study was to explore the predictive ability of a set of variables and not to determine a cause and effect relationship. These attributes of the study justifies not determining internal and external validity (Marley & Levin, 2011).

This chapter outlines the methods of data collection, the methodology used to test the proposed hypotheses and the statistical methods used for analysis. The results have been presented in detail in the subsequent chapter.

Chapter 4: Results

The purpose of this study was to examine the ability of age, gender, ethnicity, level of education, place from where prior education was obtained and the grade in the prerequisite paper to predict academic performance in the Oral Biology and Pathology paper. The study sample consisted of 118 students who had enrolled in the Oral Biology and Pathology paper from 2011 to 2014 at the Auckland University of Technology. The desensitized data of the 118 students was subject to scrutiny and the data of two students were not used for analysis, one student had withdrawn from the Oral Biology and Pathology paper and another had not completed the paper. The remaining data was subject to descriptive and inferential statistics. Inferential statistical analysis included: Pearson's correlation co-efficient and multivariable regression analysis. The relationship between the outcome variable i.e. the grade obtained in the Oral Biology and Pathology paper and each of the predictor variables was examined. The correlations among the variables was computed.

Descriptive Statistics

Sample Description

The sample consisted of predominantly female students. The sample consisted of 107 (92.2%) female students and 9 (7.8%) male students.

Of the 116 students, one student did not declare ethnicity. Of the remaining 115 students, 31 (26.7%) were Asian, 32 (27.6%) were European, 18 (15.5%) were Maori, 13 (11.2%) were Pasifika and 21 (18.1%) reported as belonging to 'other' ethnicities.

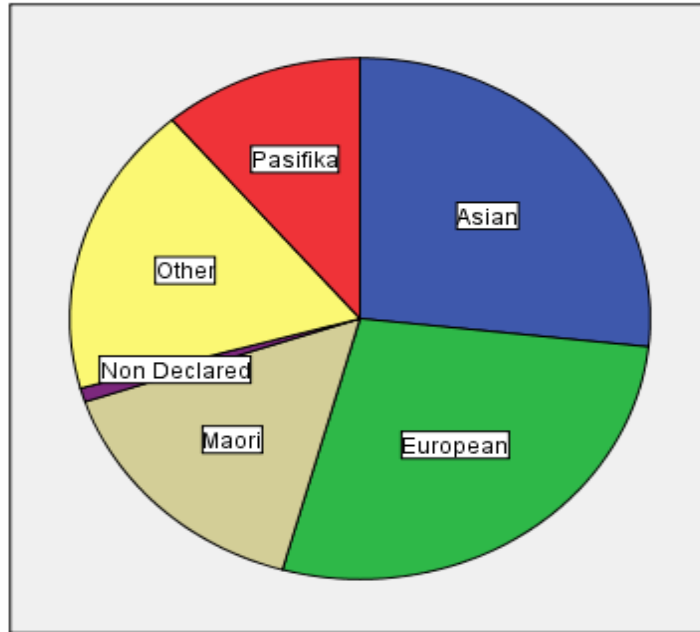


Figure 1: Pie chart showing the distribution of ethnicity in the sample

The age range in the sample was between 18 and 49. The mean age of the students was 26.5, and the median was 24.5.

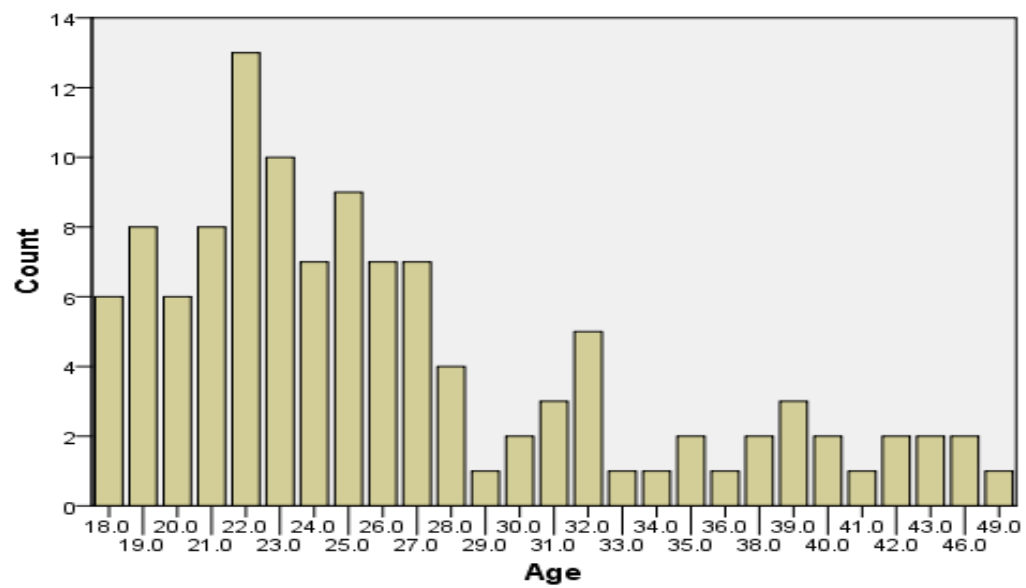


Figure 2: Bar chart showing distribution of the sample by age

In this sample, 67 students were aged 25 or under and 49 students were aged over 25. The students were categorized into two groups: 25 and under & over 25 as depicted in the Table 3 below.

Table 3

Distribution Of Students Aged 25 And Under & Over 25

		Frequency	Percent	Cumulative Percent
Valid	≤ 25	67	57.8	57.8
	>25	49	42.2	100.0
Total		116	100.0	

The students were categorized based on the level of education at enrolment in the Oral Biology and Pathology paper as shown in Table 4. The sample consisted of 55 students with prior tertiary education and 61 students whose highest prior qualification was secondary education.

Table 4

Distribution Frequency Of Students By Prior Qualifications

		Frequency	Percent	Cumulative Percent
Valid	Secondary	61	52.6	52.6
	Tertiary	55	47.4	100.0
Total		116	100.0	

When examining prior education of the students, 95 (81.9%) students had obtained prior education in New Zealand while 21 (18.1%) students had obtained prior qualifications overseas as depicted in Table 5.

Table 5

Distribution Frequency By Place From Where Prior Qualifications Were Obtained

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	New Zealand	95	81.9	81.9	81.9
	Overseas	21	18.1	18.1	100.0
	Total	116	100.0	100.0	

The examination of the work experience of the cohort revealed that 75(64.7%) students in this sample had prior work experience and the remaining 41(35.3%) had no prior work experience on enrolment in the Oral Biology and Pathology paper.

While considering the grades that the students had obtained in the prerequisite paper (Human Anatomy and Physiology II paper), it was found that 3 (2.6%) students had obtained cross credits through recognition of previous qualifications and hence did not have to enrol in the prerequisite paper. 41 (35.3%) students had obtained grades in the 'A' range. 53 (45.7%) of the students had obtained grades in the 'B' range. 19 (16.4%) had obtained grades in the 'C range'.

While considering the grades that the students had obtained in the Oral Biology and Pathology paper, it was found that 4(3.4%) students had failed the paper. 46 (39.7%) students had obtained grades in the 'A' range. 41 (35.3%) of the students had obtained grades in the 'B' range. 25 (21.6%) had obtained grades in the 'C range'.

In both the Oral Biology and Pathology paper and in the prerequisite paper, the 'A' range portrays scores between 79.50 and 100, the 'B' range portrays scores between 64.50 and 79.49, and the 'C' range portrays scores between 49.50 and 64.49. 'D' grade implies a score of equal to or less than 49.49.

Comparing means

Age

The means of the scores obtained in the Oral Biology and Pathology paper of students aged over 25 was compared with the means obtained by those 25 and under and is as depicted in the Table 6. Students over the age of 25 appear to have a marginally higher mean score.

Table 6

Comparing Means Of The Scores In The Oral Biology And Pathology Paper Between Those 25 And Under And Those Over 25

Two age groups	Mean	N	Std. Deviation
≤ 25	72.99	67	14.015
>25	77.92	49	12.342
Total	75.07	116	13.502

Gender

The means of the scores obtained in the Oral Biology and Pathology paper have been compared by gender in Table 7. The mean of the scores obtained by the female students is higher than the mean of the scores obtained by the male students.

Table 7

*Comparing Means Of The Scores In The Oral Biology
And Pathology By Gender*

Gender	Mean	N	Std. Deviation
F	75.71	107	13.572
M	67.44	9	10.442
Total	75.07	116	13.502

Ethnicity

The means of the scores obtained in the Oral Biology and Pathology paper have been compared by ethnicity (Table 8). The means of the scores when compared by ethnicity does not appear to be vastly different.

Table 8

*Comparing The Means Of The Scores In The Oral Biology And
Pathology Paper By Ethnicity*

Ethnic Group	Mean	N	Std. Deviation
Asian	74.77	31	13.099
European	75.16	32	13.963
Maori	76.11	18	12.551
Non Declared	78.00	1	
Other	75.76	21	15.694
Pasifika	72.77	13	13.097
Total	75.07	116	13.502

Level of Prior Education

The means of the scores obtained in the Oral Biology paper have been compared between those with prior tertiary education and those with prior secondary education only, as depicted in Table 9. The mean of the scores obtained by those with prior tertiary education is similar to the mean of the scores obtained by those without prior tertiary education.

Table 9

Comparing Means Of The Scores Obtained In The Oral Biology And Pathology Paper Between Students With Prior Tertiary Education And Those With Secondary Education

Level of prior education	Mean value of score in the Oral Biology and Pathology paper	N	Std. Deviation
Secondary	74.51	61	13.301
Tertiary	75.69	55	13.816
Total	75.07	116	13.502

Place from where prior education was obtained

The means of the scores obtained in the Oral Biology paper have been compared between those who had obtained prior qualifications in New Zealand with those with prior qualifications from overseas in Table 10:

Table 10

Comparing Means Of The Scored Obtained In The Oral Biology And Pathology Paper Between Students With Had Obtained Prior Education In New Zealand With Those Who Had Received Prior Education Overseas

Country of prior education	Mean	N	Std. Deviation
Overseas	73.52	21	14.268
New Zealand	75.41	95	13.381
Total	75.07	116	13.502

Work Experience

The means of the scores obtained in the Oral Biology and Pathology paper have been compared between those with work experience and those without work experience in Table 11. The mean of the scores obtained by those with work experience is marginally higher than the mean of the scores obtained by those without work experience.

Table 11

Comparing The Means Of The Scores In The Oral Biology And Pathology Paper Between Students With And Without Work Experience

Work Experience	Means of the scores in the Oral		
	Biology and Pathology paper	N	Std. Deviation
No work experience	72.05	41	14.089
Work experience	76.72	75	12.968
Total	75.07	116	13.502

Inferential Statistics

Inferential statistical analysis was carried out to test each of the four hypothesis.

- There is no relationship between factors such as age, gender, and ethnicity of the student and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between the level of prior education (in New Zealand or elsewhere) and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between work experience and academic success in the ‘Oral Biology and Pathology’ paper.
- There is no relationship between the grade in the prerequisite paper and academic success in the ‘Oral Biology and Pathology’ paper.

The statistical analyses that was used to test the above hypothesis included computing Pearson’s correlation coefficient between the grade in the Oral Biology and Pathology paper and each of the predictor variables namely: age, gender ethnicity, level of prior education, place from where prior education was obtained, work experience & the grade obtained in the prerequisite paper. The grades of the prerequisite paper and the grades of the Oral Biology and Pathology paper were subjected to a one sample t test. All the predictor variables were subjected to multivariable regression analysis with the grade in the Oral Biology and Pathology paper as the outcome variable.

Bivariate Correlations

Age and the scores in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and the two age groups (18-25 & 26-50). As shown in the Table 12, the correlation is not statistically significant as Sig (2-tailed) is greater than 0.05 and the r value of 0.181 indicates that changes in one variable is not correlated to changes in the other.

Table 12

Bivariate Correlation Analysis Between Oral Biology And Pathology Grade And The Two Age Groups

		Oral Biology and Pathology Grade	Two age groups
Oral Biology and Pathology grade	Pearson Correlation	1	0.181
	Sig. (2-tailed)		0.051
	N	116	116
Two age groups	Pearson Correlation	0.181	1
	Sig. (2-tailed)	0.051	
	N	116	116

Ethnicity and the scores in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and the various ethnicities. As shown in Table 13, the correlation is not statistically significant as Sig (2-tailed) is 0.978, which is greater than 0.05. The r value of 0.003 indicates that changes in one variable is not correlated to changes in the other.

Table 13

Bivariate Correlation Analysis Between Oral Biology And Pathology Grade And Ethnicity

		Oral Biology and Pathology grade	Ethnicity
Oral Biology and Pathology grade	Pearson	1	0.003
	Correlation		
	Sig. (2-tailed)		
	N	116	116
Ethnicity	Pearson	0.003	1
	Correlation		
	Sig. (2-tailed)		
	N	116	116

Gender and the scores in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the grades in the Oral Biology and Pathology paper and gender. As shown in Table 14, the correlation is not statistically significant as Sig (2-tailed) is 0.78, which is greater than 0.05. The r value of 0.164 indicates that changes in one variable is not correlated to changes in the other.

Table 14

Bivariate Correlation Analysis Between Oral Biology And Pathology Scores And Gender

		Oral Biology and Pathology grade	Gender
Oral Biology and Pathology grade	Pearson Correlation	1	0.164
	Sig. (2-tailed)		0.078
	N	116	116
Gender	Pearson Correlation	0.164	1
	Sig. (2-tailed)	0.078	
	N	116	116

Level of Prior Education and the scores obtained in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and the level of education. As shown in Table 15, the correlation is not statistically significant as Sig (2-tailed) at 0.640 is greater than 0.05. The r value of 0.044 indicates that changes in one variable is not correlated to changes in the other.

Table 15

Bivariate Correlation Analysis Between Oral Biology And Pathology Grade And Level Of Prior Education

		Oral Biology and Pathology grade	Level of prior education
Oral Biology and Pathology grade	Pearson Correlation	1	0.044
	Sig. (2-tailed)		0.640
	N	116	116
Level of prior education	Pearson Correlation	0.044	1
	Sig. (2-tailed)	0.640	
	N	116	116

Place of Prior Education and the scores obtained in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and place from which prior education was obtained. As shown in Table 16, the correlation is not statistically significant as Sig (2-tailed) at 0.565 is greater than 0.05. The r value of 0.054 indicates that changes in one variable is not correlated to changes in the other.

Table 16

Bivariate Correlation Analysis Between Oral Biology And Pathology Scores
And Place Of Prior Education

		Oral Biology and Pathology grade	Place of prior education
Oral Biology and Pathology grade	Level of prior education	1	0.054
	Sig. (2-tailed)		0.565
	N	116	116
Place of prior education	Pearson Correlation	0.054	1
	Sig. (2-tailed)	0.565	
	N	116	116

Work Experience and the scores obtained in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and work experience. As shown in the Table 17, the correlation is not statistically significant as Sig (2-tailed) at 0.075 is greater than 0.05 and the r value of 0.166 indicates that changes in one variable is not correlated to changes in the other.

Table 17

Correlations Between Oral Biology And Pathology Grade And Work Experience

		Oral Biology and Pathology grade	Work Experience
Oral Biology and Pathology grade	Pearson Correlation	1	0.166
	Sig. (2-tailed)		0.075
	N	116	116
Work Experience	Pearson Correlation	0.166	1
	Sig. (2-tailed)	0.075	
	N	116	116

Scores obtained in the Prerequisite paper and the scores obtained in the Oral Biology and Pathology paper

Pearson's correlation coefficient was calculated between the scores in the Oral Biology and Pathology paper and scores in the prerequisite paper. As shown in the Table 18, the correlation is statistically significant as Sig (2-tailed) at 0.000 is lesser than 0.05. It is significant at 0.001 level. The r value of 0.641 indicates that changes in one variable is correlated to changes in the other.

Table 18

Correlations Between The Grade In The Oral Biology And Pathology Paper And The Grade In The Prerequisite Paper

		Grade in Oral Biology and Pathology paper	Grade in Prerequisite paper
Grade in Oral Biology and Pathology paper	Pearson	1	0.641**
	Correlation		
	Sig. (2-tailed)		0.000
	N	116	113
Grade in Prerequisite paper	Pearson	0.641**	1
	Correlation		
	Sig. (2-tailed)	0.000	
	N	113	113

**. Correlation is significant at the 0.01 level (2-tailed).

One-Sample t test

The t test was used to compare the means of the scores obtained in the Oral Biology and Pathology paper with the means of the scores obtained in the prerequisite paper. The results of the test are depicted in Table 19. A significance of <0.00 indicates that the means of the scores in the Oral Biology and Pathology paper and the means of the scores in the prerequisite paper are not statistically significantly different.

Table 19

One-Sample t Test – Comparing Means Of The Scores Obtained In The Oral Biology And Pathology Paper With The Means Of The Scores Obtained In The Prerequisite Paper

			95% Confidence Interval of the Difference			
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Oral Biology and Pathology Scores	59.883	115	0.000	75.069	72.59	77.55
Scores in prerequisite paper	76.719	112	0.000	76.407	74.43	78.38

Multivariable regression analysis using all variables

The regression analysis was carried out using the Oral Biology and Pathology grade as the dependent or outcome variable and age, gender, ethnicity, level of prior education, place of prior education, work experience and grade obtained in the prerequisite paper as predictor or independent variables. 43.7% of the variation in grades in the Oral Biology and Pathology paper could be explained to be due to the predictor variables as indicated by the value of R square in Table 21. However only the grades in the prerequisite paper appears to be statistically significant ($p < 0.000$) as a predictor variable for the grades in the Oral Biology and Pathology paper (Table 20). The constant refers to the y intercept, the value at which the fitted line crosses the y-axis.

Table 20

Multivariable Regression Analysis Using All Variables

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	4.273	11.180		0.382	0.703
Level of prior education	-2.886	2.297	-0.108	-1.256	0.212
Country of prior education	-1.815	2.807	-0.051	-0.647	0.519
Age	0.178	0.155	0.097	1.146	0.255
Gender	5.789	3.757	0.118	1.541	0.126
Ethnicity	0.352	0.692	0.039	0.509	0.612
Grade in the prerequisite paper	0.812	.097	0.644	8.400	0.000
Work Experience	-0.478	2.391	-0.017	-0.200	0.842

Table 21

Model Summary Of The Multivariable Regression Analysis Using All Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.661 ^a	0.437	0.400	10.332

a. Predictors: (Constant), Work Experience, Gender, Country of prior education, Grade in prerequisite paper, Ethnicity, Age, Level of prior education

The histogram of dependent variable and normal P-P Plot graphs (Expected Cumulative Probability by Observed Cumulative Probability) were obtained for Oral Biology and Pathology grades. The histogram shown in Figure 3 shows that the deviation is normally distributed and the assumptions of the regression model have not be violated.

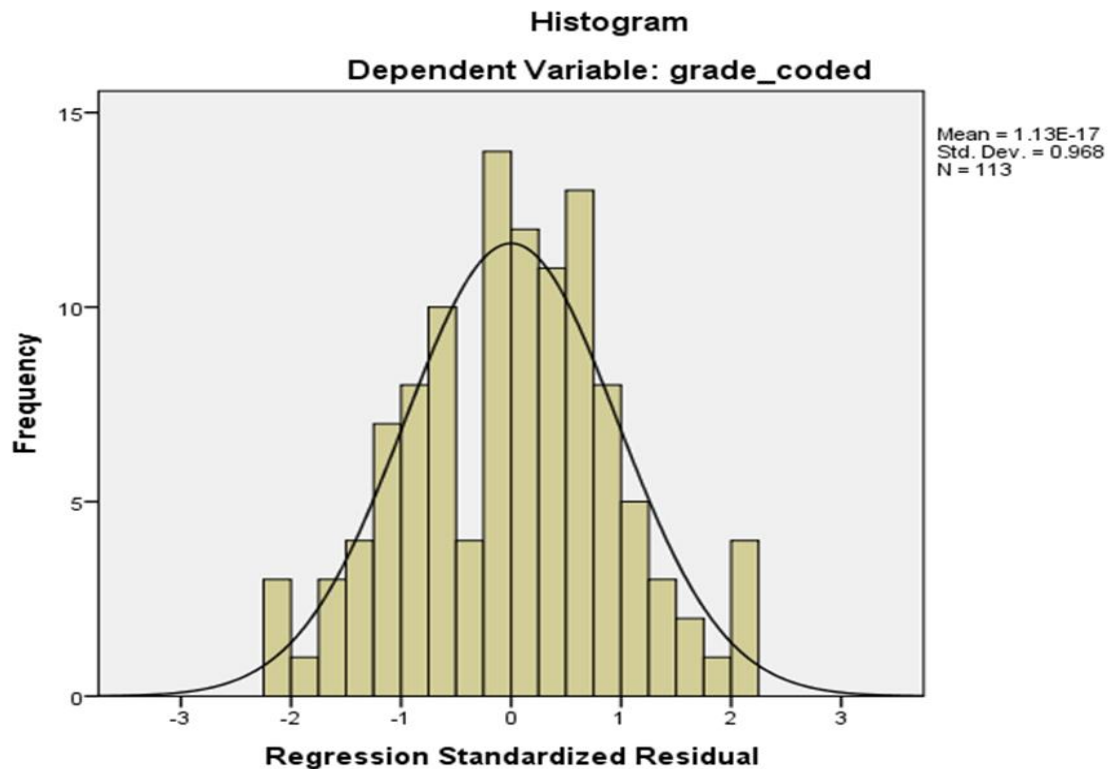


Figure 3: Histogram of the final regression model with the Oral Biology and Pathology grade (grade_coded) as the dependent variable

The probability plot in Figure 4 shows that the model is adequate and meets the assumptions of regression and that there is a strong correlation between the model's predictions and the actual results.

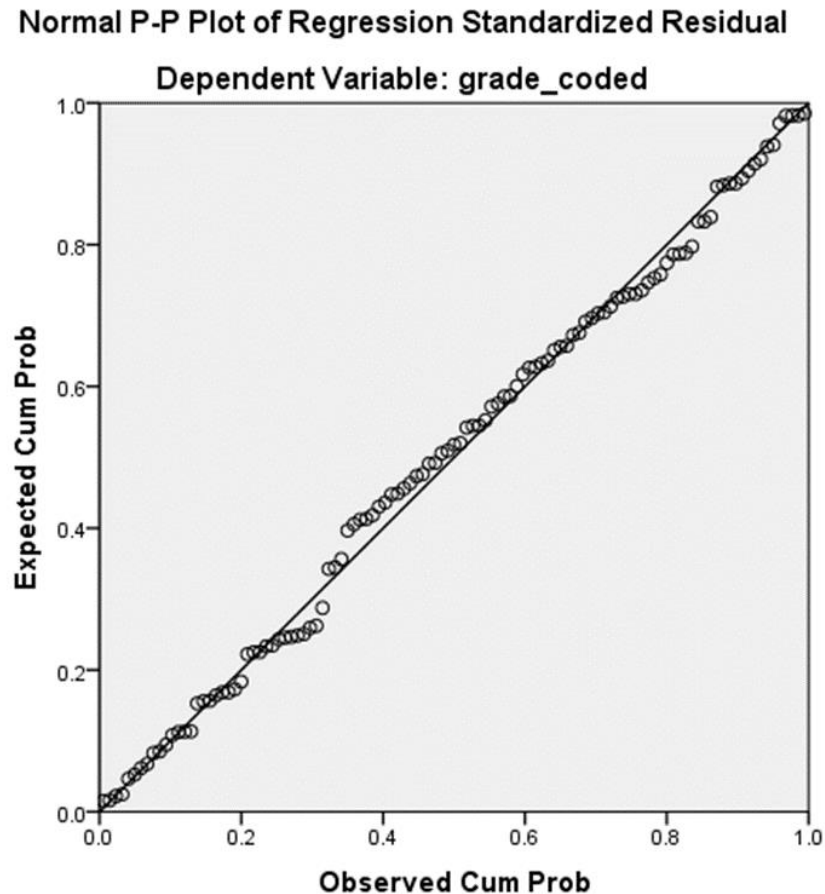


Figure 4: P-P Plot of Regression Standardized Residual

Key findings of the inferential statistical analyses

Pearson's correlation coefficient analysis demonstrated a statistically significant ($p < 0.001$) correlation between the grades obtained in the prerequisite paper and the grades obtained in the Oral Biology and Pathology paper. The r value of 0.641 indicates a fairly strong correlation between the grades obtained in the prerequisite paper and the grades obtained in the Oral Biology and Pathology paper.

A statistically significant p value ($p < 0.001$) in the one sample t test indicated that the means of the scores in the Oral Biology and Pathology paper and the means of the scores in the prerequisite paper are not statistically significantly different.

The multivariable regression analysis using all the predictor variables and the grades obtained in the Oral Biology and Pathology paper as the outcome variable resulted in a model that explained 43.7% of the variation in grades in the Oral Biology and Pathology paper. The model statistically demonstrated the predictive ability of only one of the independent variables i.e. the scores obtained in the prerequisite paper ($p < 0.001$).

Summing up: The first three proposed hypothesis have been proven to be true based on the statistical analysis of the data used for this study. Age, gender, ethnicity, level of education, place from where previous educational qualifications were obtained and work experience were neither correlated to nor predictive of the grades in the Oral Biology and Pathology paper. However based on the statistical analysis of the data, the fourth hypothesis has been proven to be wrong. The changes in the grades obtained in the prerequisite paper seem to be not only positively correlated with the grades in the Oral Biology and Pathology paper but also predictive of the grades in the Oral Biology and Pathology paper.

Chapter 5: Discussion

This study aimed to determine the ability of variables such as age at enrolment, gender, ethnicity, level of prior education, place from which prior education was obtained, work experience and grade in the prerequisite paper to predict academic performance in the Oral Biology and Pathology paper.

Oral Biology and Pathology is a bioscience paper in which students attain biomedical knowledge, an essential component for clinical practice. Good academic performance in the biosciences has been demonstrated to predict success in the clinical papers. Students who perform well in the bioscience subjects have been shown to succeed in the clinical program (Wong, & Wong, 1999). Studies have demonstrated the ability of bioscience grades to positively predict not only the final graduating grade but also success in licensure medical examinations (Peterson, & Tucker, 2005; Wong, & Wong, 1999). A study of three hundred and ninety eight school leavers who enrolled for an undergraduate dental course at the University of Western Australian revealed that previous academic performance had a strong relationship with yearly weighted average mark for Years 1 through 4 (Mercer, Abbott, & Puddey, 2013). With an understanding that the academic performance in one paper may possibly impact academic performance in the successional papers, this study was conducted using the grade obtained in the Oral Biology and Pathology paper as the outcome variable in contrast to most other studies where bioscience grades have mostly been used as predictor variables, with either the graduating grade point average or the scores in the licensure examinations as outcome variables (Peterson, & Tucker, 2005; Wong, & Wong, 1999).

The purposive sample consisted of 118 students who had enrolled in the Oral Biology and Pathology paper from 2011 to 2014. Out of the 118, the data of 116 students was used for the analysis. There was no data on the output variable for two students and cases with missing dependent or outcome variables are typically deleted (McKnight, 2007). The strengths of the sample chosen is that the number of students from each enrolment year was more or less similar. The ratio of the predictor variable to cases is closer to the ideal ratio considering that the ratio of predictor variable to cases should be at least 5:1, but ideally about 20:1 (Ntoumanis, 2001). The faculty, teaching and assessment methods including the grading criteria were also similar and studies have demonstrated that these factors influence academic

performance (Furnham, Nuygards, & Chamorro-Premuzic, 2013; Wen-Hwa, & Feng-Ming, 2014). Desensitized data was made available by the data custodian from the University's computerized data base. The desensitized data thus obtained had minimal missing information. The desensitization of data has rendered data for analysis and research without compromising data protection and with minimal missing data. The data was entered into SPSS (Version 22) and the variables were recoded for auto analysis. The data has been statistically analysed to test them using the hypothetico-deductive approach to claim a certain level of objectivity for the results obtained with the data used by obtaining some definite associations between the data collected and the hypotheses (Mack, 2012).

This study used age as a predictor variable. Those above the age of 25 were distinctly categorized from those who were 25 and under. Age has been used as a predictor variable in many such studies across disciplines but the definition of mature entrants has been inconsistent across studies (Whyte et al., 2011). While some studies have categorized anyone who has had a gap year after leaving school as a mature student (Whyte et al., 2011), others have categorized those above the age of twenty as mature students (Madigan, 2006). Yet another study has included only those students above the age of thirty as mature entrants (Mathers, & Parry, 2010). In this study, we categorized those above 25 as mature taking into account this paper is a second year paper and the mean age at enrolment in this paper was 26.5 and the median was 24.5

Though the comparative means of the Oral Biology and Pathology paper scores were favouring the older age group, inferential statistical analyses did not reveal a statistically significant correlation. Pearson's correlation coefficient did not reveal age to be a statistically correlated to the grades obtained in the Oral Biology and Pathology paper. This finding is similar to the findings by Kim and Lee in their study of dental students in Korea and they concluded that their findings disproved concerns about a decline in learning ability with an increase in age (Kim, & Lee, 2007).

Similarly a significant correlation between age and grade point average in an online course was not demonstrated when the factor of previous academic performance was controlled, forcing those authors to conclude that age is not a demographic variable that needs to be considered even for online courses when selecting students (Jost et al., 2012). This finding

of age not being predictive of academic performance is similar to our statistical findings with the multivariable regression analysis in which all other predictor variables including academic performance in the prerequisite paper was controlled.

The four students who had failed the paper were 23 and under and no student in this sample over the age of 25 had failed the paper. The failure rates in the lower age group is similar to the findings of a study in New Zealand which found that mature students were more likely to obtain their qualifications in lesser time frames (Tumen et al., 2008). While the reasons for these observations has not been explored, it offers scope for further investigations.

The two students who either withdrew or did not complete the paper also belonged to the younger age group. This finding is similar to the findings of a study involving 295 students enrolled in a tertiary bridging programme which concluded that attrition is a phenomenon involving younger participants (Whannell, 2013). The reasons for attrition was beyond the scope of this study.

Gender as a predictor variable for academic performance has been less than conclusive; with some studies concluding in favour of the female students and some in favour of the male students. The distribution by gender in this sample is skewed with an over representation of female students making comparison less unassailable. Only 7.8% of the sample comprised of male students. This ratio is more skewed than the ratio of 5:1 reported in the Bachelor of Oral Health programme at the University of Adelaide between 2003-2007 (Gardner, & Roberts-Thomson, 2012).

The results of Pearson's correlation coefficient did not indicate any statistically significant correlation between gender and the grades obtained in the Oral Biology and Pathology paper. There was no demonstrable significance when all the other predictor variables namely age, ethnicity, level of prior education, place from which prior education was obtained, work experience and grades obtained in the prerequisite paper were controlled with multivariable regression analysis either. The finding is similar to the findings reported when multivariable regression analysis was carried out using gender as one of the predictor variables for the outcome variable; dental licensure examination performance, in a study at the University of Florida (Stewart et al., 2006).

Likewise, both univariate and multivariate analysis of students' performance in both clinical and preclinical subjects using a range of predictor variables did not demonstrate gender to be a statistically significant predictor variable in the study of students enrolled in the Bachelor of Oral Health at the University of Adelaide (Gardner & Roberts-Thomson, 2012). These findings are similar to our findings with the multivariable regression analysis and the Pearson's correlation coefficient test, both of which did not statistically demonstrate any relationship between gender and grades obtained in the Oral Biology and Pathology paper.

Ethnicity has been used as a predictor variable for academic performance considering that globally students from indigenous and minority communities have been overly represented in the negative statistics (Kay-Lambkin et al., 2002; Liddell, & Koritsas, 2004). The data on ethnicity is incomplete in the sense that one student had not declared ethnicity. The means of the scores obtained in the Oral Biology and Pathology paper shows insignificant differences among the various ethnicities. The results Pearson's correlation coefficient analysis did not indicate any statistically significant correlation between ethnicity and the performance in the Oral Biology and Pathology paper. The multivariable regression analysis using all the predictor variables did not support using ethnicity as a predictor variable for the academic performance in the Oral Biology and Pathology paper.

This finding is similar to the results of a study conducted on fifth and sixth year medical students with academic and workplace assessments as the outcome variables. Ethnicity was not statistically proven to be a significant predictor variable (Carr et al., 2014). Our finding of ethnicity not being a significant predictor of a bioscience paper grade is similar to the finding of there being no ethnic differences in theoretical medical knowledge in a longitudinal study of medical students at a Dutch medical school (Stegers-Jager et al., 2012). Some of the factors that have been put forth as explanations for the poor clinical performance of minority ethnicities such as: language and communication barriers (Stegers-Jager et al., 2012) may not have been applicable to the sample of students in our study. Considering that 81.9% of the students had obtained prior education in New Zealand and the remaining 19.1% would have had to demonstrate English language proficiency through test scores in IELTS, TOEFL or other equivalent English language tests. Moreover 16 out of the 21 students who had studied overseas had prior tertiary education and 13 of those students were over the age of 25. Age could have been a favourable factor for some ethnic groups. The "broader pre-

entry training and life experience” may have contributed to their success (Wilkinson et al., 2004 p 1142). A number of reasons have been put forth as explanations for the success of older students with prior tertiary education: prior tertiary education experience, clearer motivation, interpersonal skills, developed learning style, confidence, self-directed learning, and better learning approaches for learning progression (Shehmar et al., 2010). All these factors may have been contributory to the success of ethnic minority students in the study sample.

Another factor that has been considered less favourable to ethnic minority students is subjective grading while assessing communications skills or cultural competency in clinical training (Stegers-Jager et al., 2012). The assessments for most of the learning outcomes that determined the final grade in the Oral Biology and Pathology paper was based on objective grading.

However, the four students who failed the paper belonged to ethnic minority groups, as were the two students who either withdrew or did not complete the course. These findings of failure in the paper or failure to complete the paper among ethnic minority groups is similar to the results obtained in other studies (Kay-Lambkin et al., 2002; Liddell, & Koritsas, 2004).

The quest of universities to extend access to diverse groups of candidates has resulted in a mixed cohort of students whose levels of prior education is varied, 55 of the 116 students in our sample had prior tertiary qualifications while the remaining 61 reported as having secondary school qualifications as their highest formal educational experience.

Though the means of the scores obtained in the Oral Biology and Pathology paper were similar, out of the four students who had failed the paper only one had prior tertiary qualifications. This finding of lower proportions of failures among the students with prior tertiary qualifications is similar to the study comparing medical students with and without tertiary qualifications (Manning, & Garrud, 2009).

Pearson’s correlation coefficient did not reveal any statistical correlation between the level of education and the grade obtained in the Oral Biology and Pathology paper. Academic success and level of prior education has been reported to be correlated positively by some studies (Green et al., 2003; Shehmar et al., 2010) while other studies have not found any

correlation between academic success and level of prior education (Neame et al., 1992; Rolfe et al., 2004).

Considering that the Oral Biology and Pathology paper is a second year paper, our findings are similar to the findings of the study done on medical students at Newcastle University. No differences were found between the academic performances of students irrespective of their prior educational experiences after the first year. Students who had secondary school qualifications had performed as well as those with tertiary qualifications (Kay-Lambkin et al., 2002).

Several studies on dental and medical students analysing previous academic experience have considered undergraduate science grade point average (Sandow et al., 2002) or incoming mathematics and science grade point average (Downey et al., 2002) or incoming grades in Chemistry (Lambe & Bristow, 2011). The study on the bioscience performance of nursing and paramedic students showed a clear correlation with previous study of Biology (Whyte et al., 2011). Our study did not take into consideration either the subjects that the students had studied previously or the grades obtained by them previously; though this could be justified by previous findings of a “trend of diminishing magnitude” of impact on earlier courses after the first year (Puddey & Mercer, 2014, p. 41).

Universities have enrolments from a range of students including migrants and international students, who have had no local prior educational experience. Hence the place of prior education was analysed as a predictor variable in the Oral Biology and Pathology paper. Only 18.1% of the students had obtained their previous qualifications from overseas. The means of the scores obtained in the Oral Biology and Pathology paper between the two groups was more or less similar.

The results of Pearson’s correlation coefficient analysis did not reveal any correlation between grades obtained in the Oral Biology and Pathology paper and place from where prior qualifications were obtained. The possibility of less proficiency in English among students who have studied elsewhere was attributed by the authors as contributing to the difference in performance in a study of dental students at the University of Otago (Rich et al., 2012). In our sample, all 21 students would have had to demonstrate English language proficiency through scores in English language tests as a requirement for enrolment into the programme.

16 out of the 21 students who had obtained prior education overseas had tertiary qualifications. Both these factors could be considered explanatory of the difference in the results obtained in our study.

The data we obtained did not reveal the country from which these 21 students had obtained prior education, some of them could have been from other Anglo-Saxon countries or from countries where English is used as a medium of instruction. Moreover Oral Biology and Pathology is a second year subject and a study of medical students at Newcastle University concluded that overseas medical students had academic difficulties in the first year (Kay-Lambkin et al., 2002) and these difficulties may not have persisted in the subsequent years of study and hence there may have been no demonstrable difference in the grades obtained between the two groups.

The cohort of students in the sample included students with work experience. 75 students out of the sample of 116 had work experience. However the data on the fields of work experience was incomplete and hence was not taken into consideration. The means of the scores in the Oral Biology and Pathology paper marginally favoured those with work experience.

Pearson's correlation coefficient test did not demonstrate statistically significant correlations between work experience and grades in the Oral Biology and Pathology paper. The results obtained are similar to the results obtained in the study on Pharmacy students with pharmacy related work experience (Mar et al., 2010). One of the explanations offered is that the roles held may have involved non-cognitive activities that may have been learnt at a surface level and therefore may not have contributed in any way to the Pharmacy course. Similarly a study on dental students at the Harvard School of Dental Medicine did not demonstrate any relationship between prior dental assisting experience and grades obtained in the pre-clinical and clinical assessment categories (Park et al., 2010).

In our sample, 33 out of the 41 students who did not have work experience were aged 25 and under and out of these, four students failed but none of the students with work experience had failed in the Oral Biology and Pathology paper. The difference may have been either due to age or due to the lack of work experience.

32 out of the 46 students who had scored grades in the 'A' range were students with work experience. This finding may be comparable to the conclusion in the study of dental students at the Harvard School of Dental Medicine; students with dental assisting experience were more likely to obtain an honours grade, even though dental assisting experience did not show any statistically significant correlation to the pre-clinical or clinical grades (Park et al., 2010).

Prior academic achievement has consistently been demonstrated as a reliable predictor of academic performance. In this study, we decided not to consider the academic achievement of students prior to entering this course because of the variance in how academic success would have been determined in each of the courses that the students would have completed prior to enrolling into the Bachelor of Health Science (Oral Health) programme. Moreover several studies have found that the academic performance at pre-university is not a reliable predictor of academic performance at university (Hazilah, Siti Aishah, Hazura, Saidah, Noraidah, & Ibrahim, 2013).

The decision to not consider academic achievement prior to entering university can be justified based on the results of the study on low achieving dental students where no correlation was established between the poor performance at dental school and the college grade point average (Curtis et al., 2007). Similarly, an Irish study on dental students did not demonstrate any correlation between school leaving certificate grades and final dental examination grades (Lynch et al., 2006).

The grades obtained in the prerequisite paper has been used as a measure for prior academic achievement. The grades obtained in the prerequisite paper has been statistically demonstrated to be correlated with the grades in the Oral Biology and Pathology paper with the results of the Pearson's correlation coefficient analysis. Even when all other predictor variables were controlled with the multivariable regression analysis, the grades in the prerequisite paper has emerged emphatically as a statistically significant predictor with a p value of less than 0.001.

Our findings of achievement at university as a reliable predictor of subsequent academic performance is similar to a study on accounting students. The conclusions of that study was that the best predictor of academic performance in the final year is academic achievement in earlier university examinations (Bartlett et al., 1993) and these conclusions are also

comparable to the conclusions drawn from a longitudinal study of university students in New Zealand (Tumen et al., 2008). Likewise a study of school leavers who had enrolled for an undergraduate dental course at the University of Western Australia revealed that previous academic performance had a strong relationship with yearly weighted average mark for Years 1 through 4 (Mercer et al., 2013).

Though it is not totally justifiable to compare the findings of this study to the findings of other studies considering the fact that the outcome variable, the contextual setting and the range of predictor variables used are completely dissimilar. This study adds to the literature by examining the relationship between the selected variables and the academic performance in the Oral Biology and Pathology paper. It offers a comprehensive understanding of the interactions between the variables used. These conceptual inferences have contributed to deciphering previous research in new ways. It has also enriched our understanding of predictor variables while designing new research projects.

The conclusion from the results obtained in our study is that the determining factors of academic performance in the Oral Biology and Pathology paper is not from the observed experiential characteristics of the students like level of education or work experience when they entered university but from variables like the ensuing skills they acquire during the course of study at university, as evident from the predictive ability and strong correlation between the academic performance in the prerequisite paper and the academic performance in the Oral Biology and Pathology paper. Likewise a study of medical students in Saudi Arabia found that the pre-admission variables like level of education and academic achievement prior to enrolment at university accounted for a mere 6.5% of the variations in the grade point average of medical students (Al-Rukban et al., 2010). Our finding of prior academic achievement at university as being predictive of the grades in the Oral Biology and Pathology paper is similar to the conclusion drawn following a study on the academic performance of first and third year accounting students (Bartlett et al., 1993). Tumen et al. (2008) in their longitudinal study of over seven thousand students in a New Zealand university have also identified achievement at university in the first year as a key predictor of subsequent academic performance and course completion.

In our study, the grades in the prerequisite paper has emerged as the only predictor variable that has shown an emphatic statistical significance when subjected to a battery of statistical tests using Oral Biology and Pathology grades as the outcome variable.

Chapter 6: Conclusion

The objective of this retrospective hypothetico-deductive study was to explore the ability of selected variables such as: age, gender, ethnicity, level of prior education, place from where prior education was obtained, work experience and grades obtained in the prerequisite paper; to predict academic performance in the Oral Biology and Pathology paper. The Oral Biology and Pathology paper is a discipline specific bioscience paper in the Bachelor of Health Science (Oral Health) programme at the Auckland University of Technology in New Zealand.

The results obtained in this study demonstrates that the demographic and experiential characteristics of the oral health students: age, gender, ethnicity, level of prior education, place from where prior education was obtained and work experience are not predictive of the academic performance in the Oral Biology and Pathology paper. The grade obtained in the prerequisite paper is the only variable that has been shown to be predictive of the academic performance in the Oral Biology and Pathology paper.

The grade obtained in the prerequisite paper was found to be positively correlated to the academic performance in the Oral Biology and Pathology paper as demonstrated by the results of the Pearson's correlation coefficient analysis. Even when all the other selected predictor variables were controlled with the multivariable regression analysis, the grades obtained in the prerequisite paper was a statistically significant predictor.

In conclusion, the results of this study emphatically demonstrate that the best predictor of academic success in the Oral Biology and Pathology paper is previous academic achievement at university as measured in this study by the grade obtained in the prerequisite paper rather than the demographic and experiential characteristics of the students at admission. The prerequisite paper is the Human Anatomy and Physiology II paper. This conclusion is similar to the conclusions drawn in a study of accounting students (Bartlett et al., 1993) and in a longitudinal study of university students in New Zealand (Tumen et al., 2008).

Strengths of the study

Though the statistical results obtained with this study using a limited number of variables cannot be generalized, it affirms the findings of some studies while challenging some of the beliefs generated by other studies and clearly demonstrates a need for further research.

- Though this study does not reveal in the same category as studies with large randomized samples, the chosen sample is during a four year (2011-2014) period where the faculty, curriculum, teaching methods and assessments including the grading criteria were similar and these variables have been shown to have an impact on academic performance (Furnham, Nuygards, & Chamorro-Premuzic, 2013; Wen-Hwa, & Feng-Ming, 2014).
- The cohort from each academic year is similarly sized. Though comparisons based on year of enrolment were not possible, the sample was such that each of the four years were equally represented.
- There was no selection bias considering that all students enrolled in the selected time frame were included.
- The desensitized data obtained for this study while ensuring data protection of individual students has rendered significant information for analysis with a minimal amount of missing data.
- The sample size of 116 was closer to the ideal independent variable to dependent variable ratio for multivariable analysis using all the predictor variables.

Limitations of the study

Though significant inferences can be drawn from the study, there are some limitations.

- The sample for this study has been taken from a limited time frame and from only one discipline in one institution and therefore the results obtained cannot be generalized.
- The sample size is also relatively small. It is less than ideal especially for the multivariable regression analysis that included all the independent variables.
- The outcome variable to measure academic success has been the grade obtained in the Oral Biology and Pathology paper. Academic performance is a multidimensional latent variable and grades measure only one of those dimensions of academic

achievement (Al-Turki & Duffuaa, 2003; Giada, Giovanni, & Vincenza, 2014). The final grade entered in the data base was used as the outcome variable. The number of attempts required to achieve the grade was not taken into consideration.

- Only a limited number of predictor variables have been considered, other predictor variables like: learning style, commitment, time management, level of motivation, socioeconomic status, campus climate, and personal circumstances have not been taken into consideration. Neither have predictor variables like awareness of career opportunities and awareness of the requirements for procuring jobs been taken into consideration.
- The data obtained had some gaps; for example the data on field of work experience was incomplete and hence could not be used.
- Some of the data that increased the possibility of student identification was not made available, one of which was the year of enrolment and hence no comparisons between the years was possible.
- No data was obtained either on the academic grades or on the subjects studied at school and/or at university previously.
- Gender comparisons and comparisons between those who had previously studied in New Zealand and those who hadn't would not be valid due to the skewed ratios.
- The grades were recoded for the purpose of statistical analysis. Most of the grades were recoded using the mid-point of the range used at the Auckland University of Technology. 'D' grade, which was about 3.4% of the sample was assigned a score of 48.
- The three students who were credited with the prerequisite paper were included in the multiple regression analysis. The grades in the prerequisite paper were considered as missing data. The relatively small number did not allow categorizing these students separately.

Implications for education practice.

Though the study cannot be treated as decisive, it has generated data that has implications for education practice.

- The only predictor variable in this study that has shown a positive correlation with the grades in the Oral Biology and Pathology paper is the grades obtained in the prerequisite paper. None of the other demographic or experiential characteristics of the students were statistically proven to be either correlated or predictive of the grades in the Oral Biology and Pathology paper. The conclusions drawn from this study clearly indicates the need for universities to focus on providing ample opportunities for new entrants to develop good academic skills. Providing introductory summer courses with elementary domain specific knowledge before the formal start of classes will help with both academic and social integration at university and both of these ensure academic success (Rienties et al., 2012).
- The skills acquired at university have been shown to influence academic performance more than the background characteristics that students possess at enrolment into university. Therefore bringing to question traditional admission formulas that are based on background characteristics of students at entry. Auckland University of Technology's admission criteria for student enrolment with the goal of expanding the work force seems appropriate.
- Timely prediction of failure helps remediation. Support programs have proven to be effective in turning around inadequate performances (Lindner et al., 2013; Winston et al., 2014). Student services could use predictive information like academic achievement at university to initiate activities like academic counselling, tutoring sessions, and individualized curricular activities and peer study groups that may provide a learning context to encourage student engagement. Sheltered classrooms for students at-risk could be considered.

Implications for future research

The results of this study have explicitly provided potential insights for future research.

- A prospective mixed method longitudinal study on academic performance to build a reliable predictive model is warranted. A study of this kind will lend voice to the students, unlike in the present study where student data has been reduced to numbers and their experiences have not been taken into consideration. The qualitative component of the study could help better understand the issues contributing to

academic performance. Such a longitudinal study may result in establishing a causal model.

- An investigation on the impact of a wider range of both cognitive and non-cognitive variables from when students enter university till they graduate will generate significantly more information to analyse and decipher. It will enable the isolation of differential predictors for academic and clinical performance.
- The measurement of academic performance could include not only the outcome measures but also the process measures by assessing student thinking during learning. Technology has enabled adaptive assessment of cognitive processes like problem solving through interactivity and connectivity and this could be used to measure the quality of learning and academic growth
- A longitudinal study that includes academic performance in all papers in the programme will not only help establish if good academic performance in the Oral Biology and Pathology paper predicts good performance in the clinical papers but will also make available data on the impact of the performance in other preceding papers on the performance in the Oral Biology and Pathology paper.
- A study that includes all stake holders; students, academic & non-academic staff and patients will help co-create support mechanisms to graduate a high achieving cohort of students with the skills and attitudes that are necessary for effective practice.
- Similar predictive studies in the bioscience papers of other health science disciplines at Auckland University of Technology may throw more light on the impact of the predictor variables.
- Replication of the current study using larger samples at other universities in the same discipline is warranted. Such studies could help determine if some of the findings are unique to this study.
- Prospective cohort or case controlled studies are needed to determine the predictors of post qualification proficiency.

Concluding thoughts

In conclusion, this study has identified academic performance in the prerequisite paper as the only statistically significant predictor of academic performance in the Oral Biology and Pathology paper. The grades in the prerequisite paper were positively correlated with the

grades in the Oral Biology and Pathology paper. Demographic variables like age, gender and ethnicity were not demonstrated statistically to be either predictive or correlated to the academic performance in the Oral Biology and Pathology paper. Likewise the place of prior education, the level of prior education and work experience were also not statistically demonstrated to be reliable predictors of academic performance.

While the findings of this study cannot be generalized, the most significant implication of this research is for universities and future research. While universities can use predictive data to support at-risk students and remediate the possibility of failure by facilitating academic integration, future researchers can design more robust projects to determine a causal model.

References

- Abdulghani, H. M., Al-drees, A. A., Khalil, M.S., Ahmad, F., Ponnaperuma, G.G., Amin, Z. (2014). What factors determine academic achievement in high achieving undergraduate medical students? A qualitative study. *Medical Teacher*, 36, S43-S48. doi:10.3109/0142159X.2014.886011
- Ali, P. A., & Naylor, P. B. (2010). Association between academic and non-academic variables and academic success of diploma nursing students in Pakistan. *Nurse Education Today*, 30(2), 157-162. doi: 10.1016/j.nedt.2009.07.006
- Allik, J., & Realo, A. (1997). Intelligence, academic abilities, and personality. *Personality and Individual Differences*, 23(5), 809-814. doi: 10.1016/S0191-8869(97)00103-7
- Al-Rukban, M. O., Munshi, F. M., Abdulghani, H. M., & Al-Hoqail, I. (2010). The ability of the pre-admission criteria to predict performance in a Saudi medical school. *Saudi Medical Journal*, 31(5), 560-564.
- Al-Turki, U., & Duffuaa, S. (2003). Performance measures for academic departments. *International Journal of Educational Management*, 17(7), 330-338. doi: 10.1108/09513540310501012
- Amin, Hanawi, Hazura, Saad, Sahari, & Ibrahim. (2013). Academic performance of pre-graduate students. *International Education Studies*, 6(6), 131-136. doi: 10.5539/ies.v6n6p131
- Ariyasinghe, S., & Pallegama, R. (2013). Predictors of academic performance of first year dental undergraduates in Sri Lanka: a re-evaluation following curriculum changes. *European Journal of Dental Education*, 17(1), 57-62. doi: 10.1111/eje.12014
- Bartlett, S., Peel, M. J., & Pendlebury, M. (1993). From fresher to finalist1. *Accounting Education*, 2(2), 111-122. doi: 10.1080/096392893000000013
- Bernard, H. R. (2013). *Social research methods: qualitative and quantitative approaches* (2nd ed.). Los Angeles: Sage Publications.
- Buyse, T., & Lievens, F. (2011). Situational judgment tests as a new tool for dental student selection. *Journal of Dental Education*, 75(6), 743-749.
- Carr, S. E., Celenza, A., Puddey, I. B., & Lake, F. (2014). Relationships between academic performance of medical students and their workplace performance as junior doctors. *BMC medical education*, 14(1), 157-157. doi: 10.1186/1472-6920-14-157
- Chamorro-Premuzic, T., & Furnham, A. (2003). Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of Research in Personality*, 37(4), 319-338. doi: 10.1016/S0092-6566(02)00578-0

- Chang, M. J. (2013). Post-Fisher: The unfinished research agenda on student diversity in higher education. *Educational Researcher*, 42(3), 172-173.
- Chansarkar, B. A., & Michaeloudis, A. (2001). Student profiles and factors affecting performance. *International Journal of Mathematical Education in Science and Technology*, 32(1), 97-104. doi: 10.1080/00207390120974
- Cho, Y., & Bridgeman, B. (2012). Relationship of TOEFL iBT® scores to academic performance: Some evidence from American universities. *Language Testing*, 29(3), 421-442. doi: 10.1177/0265532211430368
- Clark, A. M. (1998). The qualitative-quantitative debate: moving from positivism and confrontation to post-positivism and reconciliation. *Journal of Advanced Nursing*, 27, 1242-1249.
- Conard, M. A. (2006). Aptitude is not enough: How personality and behaviour predict academic performance. *Journal of Research in Personality*, 40(3), 339-346. doi: 10.1016/j.jrp.2004.10.003
- Creswell, J. W. (1994). *Research design: qualitative & quantitative approaches*. Thousand Oaks, California: Sage Publications.
- Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process*. Thousand Oaks, California: Sage Publications.
- Cubeta, J. F., Travers, N. L., & Sheckley, B. G. (2001). Predicting the academic success of adults from diverse populations. *Journal of College Student Retention*, 2(4), 295-311. doi: 10.2190/E9JJ-Q2GG-9RHN-N588
- Curtis, D. A., Lind, S. L., Plesh, O., & Finzen, F. C. (2007). Correlation of admissions criteria with academic performance in dental students. *Journal of Dental Education*, 71(10), 1314-1321. Retrieved from <http://www.jdentaled.org.ezproxy.aut.ac.nz/>
- Darlaston-Jones, D. (2007). Making connections: The relationship between epistemology and research methods. *The Australian Community Psychologist*, 19, 1, 19-27.
- Davey, A. K., Grant, G. D., & Anoopkumar-Dukie, S. (2013). Academic performance and personal experience of local, international, and collaborative exchange students enrolled in an Australian pharmacy program. *American Journal of Pharmaceutical Education*, 77(7), 148.
- Davies, J. R., & Warfvinge, G. (2003). Basic biology integration – the Malmo model. *European Journal of Dental Education*, 7(2), 94-94. doi: 10.1034/j.1600-0579.2003.00327.x

- DePaola, D. P. (2008). The revitalization of U.S. dental education. *Journal of Dental Education*, 72(2 Suppl), 28-42. Retrieved from <http://www.jdentaled.org.ezproxy.aut.ac.nz/>
- Dollinger, S. J., Matyja, A. M., & Huber, J. L. (2008). Which factors best account for academic success: Those which college students can control or those they cannot? *Journal of Research in Personality*, 42(4), 872-885. doi: 10.1016/j.jrp.2007.11.007
- Downey, L., Lomas, J., & Stough, C. (2014). Scholastic success: Fluid intelligence, personality, and emotional intelligence. *Personality and Individual Differences*, 60, 40-53. doi: 10.1016/j.paid.2013.07.397
- Downey, M. C., Collins, M. A., & Browning, W. D. (2002). Predictors of success in dental hygiene education: a six-year review. *Journal of Dental Education*, 66(11), 1269-1273.
- Ellen, J. R. (2005). Validity of the Medical College Admission Test for predicting medical school performance. *Academic Medicine: journal of the Association of American Medical Colleges*, 80(10), 910-917. doi: 10.1097/00001888-200510000-00010
- Farooq, I., & Ali, S. (2014). Comparison of the perceived relevance of oral biology reported by students and interns of a Pakistani dental college. *European Journal of Dental Education*, 18(4), 203-206. doi: 10.1111/eje.12086
- Fazal, S., Hussain, S., Majoka, M. I., & Masood, S. (2012). The role of study skills in academic achievement of students: a closer focus on gender. *Pakistan Journal of Psychological Research*, 27(1), 37.
- Ferguson, E., James, D., & Madeley, L. (2002). Factors associated with success in medical school: Systematic review of the literature. *BMJ: British Medical Journal*, 324(7343), 952-957. doi: 10.1136/bmj.324.7343.952
- Fields, H. W., Fields, A. M., & Beck, F. M. (2003). The impact of gender on high-stakes dental evaluations. *Journal of Dental Education*, 67(6), 654-660.
- Fischer, M. J. (2010). A longitudinal examination of the role of stereotype threat and racial climate on college outcomes for minorities at elite institutions. *Social Psychology of Education*, 13(1), 19-40. doi: 10.1007/s11218-009-9105-3
- Frambach, J. M., Driessen, E. W., Chan, L. C., & van der Vleuten, C. P. M. (2012). Rethinking the globalisation of problem-based learning: how culture challenges self-directed learning. *Medical Education*, 46(8), 738-747. doi: 10.1111/j.1365-2923.2012.04290.x
- Frischenschlager, O., Haidinger, G., & Mitterauer, L. (2005). Factors associated with academic success at Vienna Medical School: prospective survey. *Croatian Medical Journal*, 46(1), 58-65.

- Furnham, A., Nuygards, S., & Chamorro-Premuzic, T. (2013). Personality, assessment methods and academic performance. *Instructional Science*, 41(5), 975-987. doi: 10.1007/s11251-012-9259-9
- Gardner, S. P., & Roberts-Thomson, K. F. (2012). Predicting high achievers in the University of Adelaide, Australia, Bachelor of Oral Health program, 2002-09. *Journal of Dental Education*, 76(12), 1646-1656.
- Giada, A., Giovanni, B., & Vincenza, C. (2014). A new indicator for higher education student performance. *Higher Education*, 68(5), 653-668. doi: 10.1007/s10734-014-9737-x
- Gist, W. E., Goedde, H., & Ward, B. H. (1996). The influence of mathematical skills and other factors on minority student performance in principles of accounting. *Issues in Accounting Education*, 11(1), 49-60.
- Ghosh, R. (2012). Diversity and excellence in higher education: Is there a conflict? *Comparative Education Review*, 56(3), 349-365.
- Grande, J. P. (2009). Training of physicians for the twenty-first century: Role of the basic sciences. *Medical Teacher*, 31(9), 802-806. doi: 10.1080/01421590903137049
- Grant, H. (2009). Data protection 1998–2008. *Computer Law and Security Review: The International Journal of Technology and Practice*, 25(1), 44-50. doi: 10.1016/j.clsr.2008.11.005
- Green, B. N., Johnson, C. D., & McCarthy, K. (2003). Predicting academic success in the first year of chiropractic college. *Journal of Manipulative and Physiological Therapeutics*, 26(1), 40-46. doi: 10.1067/mmt.2003.9
- Grudnitski, G. (1997). A forecast of achievement from student profile data. *Journal of Accounting Education*, 15(4), 549-558. doi: 10.1016/S0748-5751(97)00024-9
- Hanassab, S., & Tidwell, R. (2002). International students in higher education: identification of needs and implications for policy and practice. *Journal of Studies in International Education*, 6(4), 305-322. doi: 10.1177/102831502237638
- Harth, S. C., Biggs, J. S., & Thong, Y. H. (1990). Mature-age entrants to medical school: a controlled study of sociodemographic characteristics, career choice and job satisfaction. *Medical Education*, 24(6), 488-498.
- Hattie, J. (2009). *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*. New York Routledge.
- Hazilah Mohd, A., Siti Aishah, H., Hazura, M., Saidah, S., Noraidah, S., & Ibrahim, M. (2013). Academic performance of pre-graduate students. *International Education Studies*, 6(6), 131-136. doi: 10.5539/ies.v6n6p131

- Hidayat, L., Vansal, S., Kim, E., Sullivan, M., & Salbu, R. (2012). Pharmacy student absenteeism and academic performance. *American Journal of Pharmaceutical Education*, 76(1), 8. doi: 10.5688/ajpe7618
- Hoare, A., & Johnston, R. (2011). Widening participation through admissions policy - a British case study of school and university performance. *Studies in Higher Education*, 36(1), 21-41. doi: 10.1080/03075070903414297
- Hogrebe, M. C., Ervin, L., Dwinell, P. L., & Newman, I. (1983). The moderating effects of gender and race in predicting the academic performance of college developmental students. *Educational and Psychological Measurement*, 43(2), 523-530. doi: 10.1177/001316448304300221
- Houltram, B. (1996). Entry age, entry mode and academic performance on a Project 2000 common foundation programme. *Journal of Advanced Nursing*, 23(6), 1089-1097. doi: 10.1046/j.1365-2648.1996.01244.x
- Huijskens, E. G. W., Hooshiaran, A., Scherpbier, A., & Van Der Horst, F. (2010). Barriers and facilitating factors in the professional careers of international medical graduates: IMGs experiences in the Netherlands. *Medical Education*, 44(8), 795-804. doi: 10.1111/j.1365-2923.2010.03706.x
- James, D., & Chilvers, C. (2001). Academic and non-academic predictors of success on the Nottingham undergraduate medical course 1970-1995. *Medical Education*, 35(11), 1056-1064. doi: 10.1046/j.1365-2923.2001.01042.x
- Jost, B., Rude-Parkins, C., & Githens, R. P. (2012). Academic performance, age, gender, and ethnicity in online courses delivered by two-year colleges. *Community College Journal of Research and Practice*, 36(9), 656-669. doi: 10.1080/10668921003744876
- Kao, G. (1995). Asian Americans as model minorities? A look at their academic performance. *American Journal of Education*, 103(2), 121-159. doi: 10.1086/444094
- Kay-Lambkin, F., Pearson, S. A., & Rolfe, I. (2002). The influence of admissions variables on first year medical school performance: a study from Newcastle University, Australia. *Medical Education*, 36(2), 154-159. doi: 10.1046/j.1365-2923.2002.01071.x
- Kelsch, M. P., & Friesner, D. L. (2014). The Health Sciences Reasoning Test in the Pharmacy admissions process. *American Journal of Pharmaceutical Education*, 78(1), 1-5.
- Kidder, W. C. (2000). Portia denied: unmasking gender bias on the LSAT and its relationship to racial diversity in legal education. *Yale Journal of Law and Feminism*, 12(1), 1.

- Kim, M., & Lee, J. I. (2007). Variables predicting students' first semester achievement in a graduate-entry dental school in Korea. *Journal of Dental Education*, 71(4), 550.
- Kivlighan, D. M. (2008). Compositional diversity and the research productivity of PhD graduates. *Journal of Diversity in Higher Education*, 1(1), 59-66. doi: 10.1037/1938-8926.1.1.59
- Koh, M. Y., & Koh, H. C. (1999). The determinants of performance in an accountancy degree programme. *Accounting Education*, 8(1), 13-29. doi: 10.1080/096392899331017
- Kornguth, M., Frisch, N., Shovein, J., & Williams, R. (1994). Noncognitive factors that put students at academic risk in nursing programs. *Nurse Educator*, 19(5), 24-27. doi: 10.1097/00006223-199409000-00017
- Krumrei-Mancuso, E. J., Newton, F.B., Kim, E., Wilcox, D. (2013). Psychosocial factors predicting first-year college student success. *Journal of College Student Development*, 54(3), 247-266. doi: 10.1353/csd.2013.0034
- Kuncel, N. R., Wee, S., Serafin, L., & Hezlett, S. A. (2010). The validity of the graduate record examination for Master's and Doctoral programs: A meta-analytic investigation. *Educational and Psychological Measurement*, 70(2), 340-352. doi: 10.1177/0013164409344508
- Lambe, P., & Bristow, D. (2011). Predicting medical student performance from attributes at entry: a latent class analysis. *Medical Education*, 45(3), 308-316. doi: 10.1111/j.1365-2923.2010.03897.x
- Lee, W. Y. (2002). Culture and institutional climate: Influences on diversity in higher education. *The Review of Higher Education*, 25(3), 359-368. doi: 10.1353/rhe.2002.0014
- Lee, S. A., Park, H. S., & Kim, W. (2009). Gender differences in international students' adjustment. *College Student Journal*, 43(4), 1217-1227.
- Li, G., Chen, W., & Duanmu, J. (2010). Determinants of international students' academic performance: A comparison between Chinese and other international students. *Journal of Studies in International Education*, 14(4), 389-405. doi: 10.1177/1028315309331490
- Liddell, M. J., & Koritsas, S. (2004). Effect of medical students' ethnicity on their attitudes towards consultation skills and final year examination performance. *Medical Education*, 38(2), 187-198. doi: 10.1111/j.1365-2923.2004.01753.x
- Lindner, I., Sacks, D., Sheakley, M., Seidel, C., Wahlig, B. C., Rojas, J. D., & Coleman, M. T. (2013). A pre-matriculation learning program that enables medical students with low prerequisite scores to succeed. *Medical Teacher*, 35(10), 872-873. doi: 10.3109/0142159X.2013.786812

- Lucas, P., Lenstrup, M., Prinz, J., Williamson, D., Yip, H., & Tipoe, G. (1997). Language as a barrier to the acquisition of anatomical knowledge. *Medical Education*, 31(2), 81-86.
- Lynch, C. D., McConnell, R. J., & Hannigan, A. (2006). Dental school admissions in Ireland: can current selection criteria predict success? *European Journal of Dental Education*, 10(2), 73-79. doi: 10.1111/j.1600-0579.2006.00398.x
- Mack, L. (2010). The philosophical underpinnings of educational research. *Polyglossia*, 19, 5-11
- Madigan, V. (2006). Predicting prehospital care students' first-year academic performance. *Prehospital Emergency Care*, 10(1), 81-88. doi: 10.1080/10903120500366037
- Maksy, M. M., & Zheng, L. (2008). Factors associated with student performance in advanced accounting and auditing. *Accounting Research Journal*, 21(1), 16-32. doi: 10.1108/10309610810891328
- Manning, G., & Garrud, P. (2009). Comparative attainment of 5-year undergraduate and 4-year graduate entry medical students moving into foundation training. *BMC Medical Education*, 9(1), 76-80. doi: 10.1186/1472-6920-9-76
- Mar, E., Barnett, M. J., T-L Tang, T., Sasaki-Hill, D., Kuperberg, J. R., & Knapp, K. (2010). Impact of previous pharmacy work experience on pharmacy school academic performance. *American Journal of Pharmaceutical Education*, 74(3), 42(41-47). doi: 10.5688/aj740342
- Marley, S. C., & Levin, J. R. (2011). When are prescriptive statements in educational research justified? *Educational Psychology Review*, 23(2), 197-206. doi: 10.1007/s10648-011-9154-y
- Marshall, P. (1995). Singaporean students in British higher education: the statistics of success. *Engineering Science and Education Journal*, 4(4), 155-160. doi: 10.1049/esej:19950405
- Martin, A. J., Wilson, R., Liem, G. D., & Ginns, P. (2013). Academic momentum at university/college: Exploring the roles of prior learning, life experience, and ongoing performance in academic achievement across time. *The Journal of Higher Education*, 84(5), 640-674.
- Martin, S. (2003). Impact of a graduate entry programme on a medical school library service. *Health Information and Libraries Journal*, 20(1), 42-49. doi: 10.1046/j.1471-1842.2003.00396.x
- Mathers, J., & Parry, J. (2010). Older mature students' experiences of applying to study medicine in England: an interview study. *Medical Education*, 44(11), 1084-1094. doi: 10.1111/j.1365-2923.2010.03731.x

- Maslov Kruzicevic, S., Barisic, K. J., Banozic, A., Esteban, C. D., Sapunar, D., & Puljak, L. (2012). Predictors of attrition and academic success of medical students: a 30-year retrospective study. *PloS one*, 7(6), e39144-e39144. doi: 10.1371/journal.pone.0039144
- Masui, C., Broeckmans, J., Doumen, S., Groenen, A., & Molenberghs, G. (2014). Do diligent students perform better? Complex relations between student and course characteristics, study time, and academic performance in higher education. *Studies in Higher Education*, 39(4), 621-643. doi: 10.1080/03075079.2012.721350
- McHugh, M. L. (2013). The chi-square test of independence. *Biochemia Medica*, 23(2), 143-149. doi: 10.11613/BM.2013.018
- McKenzie, K., & Schweitzer, R. (2001). Who succeeds at university? Factors predicting academic performance in first year Australian university students. *Higher Education Research & Development*, 20(1), 21-33. doi: 10.1080/07924360120043621
- McKnight, P. E. (2007). *Missing data: a gentle introduction*. New York: Guilford Press.
- Meeuwisse, M., Born, M. P., & Severiens, S. E. (2013). Academic performance differences among ethnic groups: do the daily use and management of time offer explanations? *Social Psychology of Education*, 16(4), 599-615. doi: 10.1007/s11218-013-9231-9
- Mercer, A., Abbott, P. V., & Puddey, I. B. (2013). Relationship of selection criteria to subsequent academic performance in an Australian undergraduate dental school. *European Journal of Dental Education*, 17(1), 39-45. doi: 10.1111/eje.12005
- Michelle, O. (2011). Student satisfaction and student performance. *Journal of Applied Research in the Community College*, 19(1), 50-56.
- Miguel-Vázquez, V., Bartolomei-Suárez, S., & Grey, W., R. (2013). The socio-economic background effect on UPRM Engineering students' academic performance. *IIE Annual Conference. Proceedings U6*, 587-596.
- Miller, L. S. (2005). Exploring High Academic Performance: The case of Latinos in higher education. *Journal of Hispanic Higher Education*, 4(3), 252-271. doi: 10.1177/1538192705276549
- Mills, B. A., & Harmer-Beem, M. (2008). Predicting student success in a three year associate degree dental hygiene program using a practical programmatic model. *Journal of Dental Hygiene*, 82(5), 54-54.
- Morrison, J., Merrick, B., Higgs, S., & Metais, L. (2005). Researching the performance of international students in the UK. *Studies in Higher Education*, 30(3), 327-337. doi: 10.1080/03075070500095762

- Neame, R. L., Powis, D. A., & Bristow, T. (1992). Should medical students be selected only from recent school-leavers who have studied science? *Medical Education*, 26(6), 433-440.
- Nelson, E. J. (1954). The verification theory of meaning. *The Philosophical Review*, 63(2), 182-192.
- Ng, V., Koh, D., & Chia, S.-E. (2003). Examination stress, salivary cortisol, and academic performance. *Psychological Reports*, 93(3 Pt 2), 1133-1134. doi: 10.2466/pr0.2003.93.3f.1133
- Nguyen, N. T., Allen, L. C., & Fraccastoro, K. (2005). Personality predicts academic performance: Exploring the moderating role of gender. *Journal of Higher Education Policy and Management*, 27(1), 105-117. doi: 10.1080/13600800500046313
- Nonis, S. A., Hudson, G. I., Philhours, M. J., & Teng, J. K. (2005). Changes in college student composition and implications for marketing education: revisiting predictors of academic success. *Journal of Business Research*, 58(3), 321-329. doi: 10.1016/j.jbusres.2003.06.001
- Nout, M. A., & Aishah, M. A. (2014). The impact of demographic and academic characteristics on academic performance. *International Business Research*, 7(4), 92-100. doi: 10.5539/ibr.v7n4p92
- Ntoumanis, N. (2001). *A step-by-step guide to SPSS for sport and exercise studies*. New York: Routledge.
- O'Connor, M. C., & Paunonen, S. V. (2007). Big five personality predictors of post-secondary academic performance. *Personality and Individual Differences*, 43(5), 971-990. doi: 10.1016/j.paid.2007.03.017
- Odom, K. L., Roberts, L. M., Johnson, R. L., & Cooper, L. A. (2007). Exploring obstacles to and opportunities for professional success among ethnic minority medical students. *Academic Medicine: Journal of the Association of American Medical Colleges*, 82(2), 146-153. doi: 10.1097/ACM.0b013e31802d8f2c
- Ofori, R. (2000). Age and 'type' of domain specific entry qualifications as predictors of student nurses' performance in biological, social and behavioural sciences in nursing assessments. *Nurse Education Today*, 20(4), 298-310. doi: 10.1054/nedt.1999.0396
- O'Leary, Z. (2004). *The essential guide to doing research*. London: SAGE.
- Park, G., & French, B. F. (2013). Gender differences in the foreign language classroom anxiety scale. *System: An International Journal of Educational Technology and Applied Linguistics*, 41(2), 462-471.

- Park, S. E., Da Silva, J. D., Barnes, J. L., Susarla, S. M., & Howell, T. H. (2010). Predicting dental school performance based on prior dental experience and exposure. *European Journal of Dental Education: official journal of the Association for Dental Education in Europe*, 14(1), 1-6. doi: 10.1111/j.1600-0579.2009.00611.x
- Pellizzari, M., & Billari, F. C. (2012). The younger, the better?: Age-related differences in academic performance at university. *Journal of Population Economics*, 25(2), 697-739. doi: 10.1007/s00148-011-0379-3
- Peterson, C. A., & Tucker, R. P. (2005). Medical gross anatomy as a predictor of performance on the USMLE Step 1. *Anatomical record. Part B, New anatomist*, 283(1), 5-8. doi: 10.1002/ar.b.20054
- Picot, G., & Hou, F. (2013). Why immigrant background matters for university participation: a comparison of Switzerland and Canada. *International Migration Review*, 47(3), 612-642. doi: 10.1111/imre.12038
- Poole, A., Catano, V. M., & Cunningham, D. P. (2007). Predicting performance in Canadian dental schools: the new CDA structured interview, a new personality assessment, and the DAT. *Journal of Dental Education*, 71(5), 664-676.
- Platt, L. S., Turocy, P. S., & McGlumphy, B. E. (2001). Preadmission criteria as predictors of academic success in entry-level athletic training on other allied health educational programs. *Journal of Athletic Training*, 36(2), 141-144.
- Puddey, I. B., & Mercer, A. (2014). Predicting academic outcomes in an Australian graduate entry medical programme. *BMC Medical Education*, 14(1), 31-43. doi: 10.1186/1472-6920-14-31
- Ranasinghe, P., Ellawela, A., & Gunatilake, S. B. (2012). Non-cognitive characteristics predicting academic success among medical students in Sri Lanka. *BMC Medical Education*, 12(1), 66(1)-66(6). doi: 10.1186/1472-6920-12-66
- Raval, N., gan, I. F., Hosseinzadeh, L., Yaghoub-Zadeh, S., Molnar, N., Hamlin, J., & Vrazic, D. (2008). The academic environment: the students' perspective. *European Journal of Dental Education*, 12(s1), 120-130. doi: 10.1111/j.1600-0579.2007.00494.x
- Reibnegger, G., Caluba, H.-C., Ithaler, D., Manhal, S., Neges, H. M., & Smolle, J. (2010). Progress of medical students after open admission or admission based on knowledge tests. *Medical Education*, 44(2), 205-214. doi: 10.1111/j.1365-2923.2009.03576.x
- Rich, A. M., Ayers, K. M. S., Thomson, W. M., Sinclair, R. J., Rohan, M. J., & Seymour, G. J. (2012). Does performance in selection processes predict performance as a dental student? *European Journal of Dental Education*, 16(1), 27-34. doi: 10.1111/j.1600-0579.2011.00706.x

- Richardson, J. T. E. (1994). Mature students in higher education: Academic performance and intellectual ability. *Higher Education*, 28(3), 373-386. doi: 10.1007/BF01383723
- Richardson, P. H., Winder, B., Briggs, K., & Tydeman, C. (1998). Grade predictions for school-leaving examinations: do they predict anything? *Medical Education*, 32(3), 294-297. doi: 10.1046/j.1365-2923.1998.00225.x
- Rienties, B., Beausaert, S., Grohnert, T., Niemantsverdriet, S., & Kommers, P. (2012). Understanding academic performance of international students: the role of ethnicity, academic and social integration. *Higher Education*, 63(6), 685-700. doi: 10.1007/s10734-011-9468-1
- Rindermann, H., & Neubauer, A. C. (2001). The influence of personality on three aspects of cognitive performance: processing speed, intelligence and school performance. *Personality and Individual Differences*, 30(5), 829-842. doi: 10.1016/S0191-8869(00)00076-3
- Roberts, S. J., & Stott, T. (2015). A new factor in UK students' university attainment: the relative age effect reversal? *Quality Assurance in Education*, 23(3), 295-305. doi: 10.1108/QAE-01-2013-0008
- Rolfe, I. E., Ringland, C., & Pearson, S. A. (2004). Graduate entry to medical school? Testing some assumptions. *Medical Education*, 38(7), 778-786. doi: 10.1111/j.1365-2929.2004.01891.x
- Salamonson, Y., Everett, B., Koch, J., Andrew, S., & Davidson, P. M. (2012). The impact of term-time paid work on academic performance in nursing students: a longitudinal study. *International Journal of Nursing Studies*, 49(5), 579-585. doi: 10.1016/j.ijnurstu.2011.10.012
- Sandow, P. L., Jones, A. C., Peek, C. W., Courts, F. J., & Watson, R. E. (2002). Correlation of admission criteria with dental school performance and attrition. *Journal of Dental Education*, 66(3), 385-392.
- Sawair, F. A., Baqain, Z. H., Al-Omari, I. K., Wahab, F. K., & Rajab, L. D. (2009). Effect of gender on performance of undergraduate dental students at the University of Jordan, Amman. *Journal of Athletic Training*, 73(11), 1313-1319.
- Schauber, S. K., Hecht, M., M., Nouns, Z., & Dettmer, S. (2013). On the role of biomedical knowledge in the acquisition of clinical knowledge. *Medical Education*, 47(12), 1223-1235. doi: 10.1111/medu.12229
- Scheven, B. A. A. (2012). Perceived relevance of oral biology by dental students. *European Journal of Dental Education*, 16(1), e64-e72. doi: 10.1111/j.1600-0579.2011.00677.x

- Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, 5(9), 9-16. doi: 10.5539/elt.v5n9p9
- Shanahan, M. M. (2004). Does age at entry have an impact on academic performance in occupational therapy education? *The British Journal of Occupational Therapy*, 67(10), 439-446. doi: 10.1177/030802260406701004
- Sheard, M. (2009). Hardiness commitment, gender, and age differentiate university academic performance. *The British Journal of Educational Psychology*, 79(Pt 1), 189-204.
- Shehmar, M., Haldane, T., Price-Forbes, A., Macdougall, C., Fraser, I., Peterson, S., & Peile, E. (2010). Comparing the performance of graduate-entry and school-leaver medical students: Comparison of graduate-entry and school-leaver students. *Medical Education*, 44(7), 699-705. doi: 10.1111/j.1365-2923.2010.03685.x
- Shulruf, B., Poole, P., Wang, G. Y., Rudland, J., & Wilkinson, T. (2012). Some light in the fog? *Advances in Health Sciences Education*, 17(5), 631-632. doi: 10.1007/s10459-012-9413-9
- Simpson, J., & Cooke, M. (2009). Movement and loss: progression in tertiary education for migrant students. *Language and Education*, 24(1), 57-73. doi: 10.1080/09500780903194051
- Sintayehu, M. (2014). Problems challenging the academic performance of physics students in higher governmental institutions in the case of Arbaminch, Wolayita Sodo, Hawassa and Dilla universities. *Natural Science*, 6, 362-375. doi: 10.4236/ns.2014.65037
- Smithers, S., Catano, V. M., & Cunningham, D. P. (2004). What predicts performance in Canadian dental schools? *Journal of Dental Education*, 68(6), 598.
- Stanley, S., & Sumie, O. (1990). Asian-American educational achievements: A phenomenon in search of an explanation. *American Psychologist*, 45(8), 913-920. doi: 10.1037/0003-066X.45.8.913
- Stegers-Jager, K. M., Steyerberg, E. W., Cohen-Schotanus, J., & Themmen, A. P. N. (2012). Ethnic disparities in undergraduate pre-clinical and clinical performance. *Medical Education*, 46(6), 575-585. doi: 10.1111/j.1365-2923.2012.04265.x
- Stewart, C. M., Bates, J. R. E., Smith, G. E., & Young, L. (2006). Impact of gender on dental state licensure examination performance. *Journal of Dental Education*, 70(5), 525-530.

- Tickell, & Smyrnios. (2005). Predictors of tertiary accounting students' academic performance: A comparison of Year 12-to-university students with TAFE-to-university students. *Journal of Higher Education Policy and Management*, 27(2), 239-259. doi: 10.1080/13600800500120142
- Trueman, M., & Hartley, J. (1996). A comparison between the time-management skills and academic performance of mature and traditional-entry university students. *Higher Education*, 32(2), 199-215. doi: 10.1007/BF00138396
- Tumen, S., Shulruf, B., & Hattie, J. (2008). Student pathways at the university: patterns and predictors of completion. *Studies in Higher Education*, 33(3), 233-252. doi: 10.1080/03075070802049145
- Unni, E. J., Zhang, J., Radhakrishnan, R., Smith, K. P., Bridgen, C. M., DeYoung, M. H., & Metzger, T. G. (2011). Predictors of academic performance of pharmacy students based on admission criteria in a 3-year pharmacy program. *Currents in Pharmacy Teaching and Learning*, 3(3), 192-198. doi: 10.1016/j.cptl.2011.04.006
- Uppal, N., & Mishra, S. K. (2014). Moderation effects of personality and organizational support on the relationship between prior job experience and academic performance of management students. *Studies in Higher Education*, 39(6), 1022-1038. doi: 10.1080/03075079.2013.777411
- Verónica, M.-V., Sonia, B.-S., & William, R. G. (2013). The socio-economic background effect on UPRM engineering students' academic performance. *IIE Annual Conference. Proceedings U6*, 587-596.
- Watson, R. (2003). Research notes: don't let statistics frighten you--use the SPSS. *Nursing Standard*, 18(1), 21.
- Weber, R. (2004). Editor's Comments: The rhetoric of positivism versus interpretivism: A personal view. *MIS Quarterly*, 28(1), iii-xii.
- Wen-Hwa, K., & Feng-Ming, C. (2014). Teaching quality, learning satisfaction, and academic performance among hospitality students in Taiwan. *World Journal of Education*, 4(5), 11. doi: 10.5430/wje.v4n5p11
- Whannell, R. (2013). Predictors of attrition and achievement in a tertiary bridging program. *Australian Journal of Adult Learning*, 53(2), 280-310.
- Whyte, D. G., Madigan, V., & Drinkwater, E. J. (2011). Predictors of academic performance of nursing and paramedic students in first year bioscience. *Nurse Education Today*, 31(8), 849-854. doi: 10.1016/j.nedt.2010.12.021
- Wilkinson, T. J., Wells, J. E., & Bushnell, J. A. (2004). Are differences between graduates and undergraduates in a medical course due to age or prior degree? *Medical Education*, 38(11), 1141-1146. doi: 10.1111/j.1365-2929.2004.01981.x

- Winston, K. A., Van Der Vleuten, C.P.M., & Scherpbier, J. J. A. (2014). Prediction and prevention of failure: An early intervention to assist at-risk medical students. *Medical Teacher*, 36, 25-31. doi:10.3109/0142159X.2013.836270
- Wong, J., & Wong, S. (1999). Contribution of basic sciences to academic success in nursing education. *International Journal of Nursing Studies*, 36(4), 345-354. doi: 10.1016/S0020-7489(99)00032-2
- Woods, N. N. (2007). Science is fundamental: the role of biomedical knowledge in clinical reasoning. *Medical Education*, 41(12), 1173-1177. doi: 10.1111/j.1365-2923.2007.02911.x
- Yang, B., & Lu, D. R. (2001). Predicting academic performance in management education: An empirical investigation of MBA success. *Journal of Education for Business*, 77(1), 15-20. doi: 10.1080/08832320109599665
- Yip, M. C. W., & Chung, O. L. L. (2005). Relationship of study strategies and academic performance in different learning phases of higher education in Hong Kong. *Educational Research and Evaluation*, 11(1), 61-70. doi: 10.1080/13803610500110414
- Yockey, R. D. (2011). *SPSS demystified: a step-by-step guide to successful data analysis: for SPSS version 18.0* (2nd ed.). Boston, Massachusetts: Prentice Hall/Pearson.
- Zhao, Y., & Qiu, W. (2009). How good are the Asians? Refuting four myths about Asian-American academic achievement. *The Phi Delta Kappan*, 90(5), 338-344. doi: 10.1177/003172170909000507
- Zuriff, G. E. (2003). A method for measuring student study time and preliminary results. *College Student Journal*, 37(1), 72-78.