Learning style preferences of chiropractic students at a university of technology and their effect on academic performance

By

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Dissertation submitted in partial fulfilment of the requirements for the

Master's Degree in Technology: Chiropractic

Durban University of Technology

October 2021

I, Kate Dinkelmann, do declare that this dissertation is representative of my own work in both conception and execution (except where acknowledgements indicate to the contrary)

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PREFACE

The investigations described in this dissertation were conducted at the Durban University of Technology, KwaZulu-Natal, South Africa, from April 2019 to July 2021, supervised by Dr F. Ally and co-supervised by Dr C. Prince.

This research study is the original work of the author and has not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others, it is duly acknowledged in the text.

FACULTY OF HEALTH SCIENCES DECLARATION – PLAGIARISM

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ABSTRACT

Background

South Africa's higher education institutions have been described as systems of low participation and high attrition (Cloete 2014:1358). Despite the government's investments into its education sector, graduation rates, especially those at the undergraduate level, remain very low. A diversified student body makes up the tertiary education institutions. These students vary in age, gender, race and socioeconomic backgrounds, which have fuelled the need to investigate strategies to improve the learning experience so students may achieve their full potential. There is a paucity of research specific to learning style preferences and chiropractic education with many of those studies done not being applicable to a university of technology in South Africa.

Aim

The aim of the study was to determine the learning style preferences of registered chiropractic students at the Durban University of Technology, In KwaZulu-Natal, South Africa, and to determine the relationship of these preferences to their demographics and academic performance.

Research methodology

Using a quantitative research approach, 142 chiropractic students registered in years one to five of the chiropractic programme in 2019 were asked to complete a cross-sectional survey comprised of basic demographical information and a Visual, Aural, Read/write and Kinaesthetic (VARK) questionnaire. The research tool was administered through QuestionPro, and later hard copies of the questionnaire were offered if the respondents were unable to initially complete the online questionnaire.

Results and discussion

There were 101 chiropractic students who participated in this study resulting in a 76.5% response rate. The majority of the students were found to be unimodal learners (61.4%) and the most selected unimodal preference was the kinaesthetic mode (36.6%). No significant difference in the distribution of learning style preferences were found by year of study, gender or age (p=0.893, p=0.228 and p=0.153, respectively), although a slight trend was observed, where read/write learning was the more popular preference amongst the youngest and visual learning was preferred amongst the oldest students. This research study also found there to be no significant relationship between learning style preferences and academic performance in theory and practical examinations (p=0.161 and p=0.083, respectively).

Conclusion and recommendations

Although many of the chiropractic students were found to have unimodal preferences, this study highlighted the diversity of learning style preferences amongst the students. No specific learning styles were found to predict a better examination outcome but allowing students to explore their learning preferences and utilize techniques that are best suited to them may enhance their education. Future studies should examine the learning style preferences of the chiropractic lecturers and clinicians, and compare these with the preferences of the students, who typically adapt their learning preferences to suit their learning environment (Almigbal 2015:349).

Key words

Academic performance, chiropractic, learning style preferences, South Africa, VARK.

ACKNOWLEDGMENTS

Dr Fazila Ally, my supervisor, your knowledge and support throughout this dissertation has been invaluable.

Dr Cleo Prince, thank you for being my co supervisor. Your guidance is greatly appreciated.

Thank you Dr Charmaine Korporaal, for helping me understand the “ins and outs” of chiropractic and for always making time in your incredibly busy schedule to assist me.

To my parents, Vanessa and Garth Dinkelmann, thank you both for your love, guidance and generous opportunities that you have given me.

My brother, Ross, thank you for being in my corner and providing me with endless encouragement.

Geoffrey Woollatt, my love, thank you for patiently supporting me while I complete my chiropractic studies. Your love and level-headed advice are so appreciated.

To my dear friends and family, community is the foundation to success. Thank you all for your positivity and motivation.

The DUT chiropractic students, without you this research would not have been possible. Thank you for your participation and interest in this study.

Thank you to all my lecturers, the clinicians and the staff of the Chiropractic Department for their contributions which allowed me to reach this point.

Thank you to the Durban University of Technology for funding this research.

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GLOSSARY OF TERMS

Chiropractic: *"Chiropractic is a health profession concerned with the diagnosis, treatment and prevention of mechanical disorders of the musculoskeletal system, and the effects of these disorders on the function of the nervous system and general health. There is an emphasis on manual treatments including spinal adjustment and other joint and soft-tissue manipulation"* (WFC 2001).

Learning style: The method in which individuals gather, process, interpret, organise and think about new material or gain skills (Whillier *et al.* 2014: 21).

Participation rate: The percentage of 20-24 year olds of the general population enrolled in higher education (Council on Higher Education, 2018: iv).

LIST OF ABBREVIATIONS AND ACRONYMS

VARK:	Visual, Aural, Read/write, Kinaesthetic
NSC:	National Senior Certificate
UoT:	University of Technology
TU:	Traditional University
DUT:	Durban University of Technology
OSCE:	Objective Structured Clinical Examination
LASSI:	Learning and Study Strategies Inventory
GPA:	Grade Point Average
NBCE:	National Board of Chiropractic Examiners
Gen Z:	Generation Z
IREC:	Institutional Research Ethics Committee
POPI:	Protection of Personal Information
SPSS:	Statistical Package for Social Sciences
ANOVA:	Analysis of Variance

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

The purpose of this study was to determine the learning style preferences of registered chiropractic students at the Durban University of Technology (DUT) and to determine the relationship of these preferences to their demographics and academic performance. This study grew out of the need to understand the possible barriers and/or challenges that chiropractic students may face.

The outcomes of this study may be considered by the academics of the Chiropractic Department as they continue to make curriculum changes that support improved academic performance and work towards the goal of ENVISION 2030. According to Professor Mthembu, DUT Vice-Chancellor and Principal, by 2030 DUT will establish itself as “people-centred and engaged”, as well as “innovative and entrepreneurial” (Zuma 2020).

This chapter begins by discussing the historical and current state of education in South Africa and introduces learning styles as a method of intervention towards improving of the learning experience. Following the rationale of the study, the motivation and the significance of this research study will be discussed. The research aim, objectives, assumptions and delimitations will be stated and a summary of the subsequent chapters will be presented.

1.2 RATIONALE FOR STUDY

More than two decades post the abolishment of the apartheid system, in 1994, South Africa is still working to address past inequalities and to transform the higher education system to meet the needs of a larger and more diverse student body (Mekoa 2018:227). Education is vital to South Africa’s long-term development. Producing life-long learners allows for increased productivity and therefore economic growth (National Planning Commission 2013:264).

After the release of Nelson Mandela in 1990, creating equality in education was near the top of the African National Congress's list of priorities because education had been used as a tool of segregation by the discriminatory government (Jackson 2016:12). Since then, even with the massive investments into the education system at tertiary levels, there has not been improved outcomes in terms of the level of performance nor the graduation rates (Cloete 2014:1358).

The shift of additional resources towards tertiary education has made it difficult to maintain the quality of education in an increasing primary and secondary school enrolment. This has resulted in a discontinuity between prior learning and the expectations of the institutions, also referred to as an "*articulation gap*" (Tewari and Ilesanmi 2020:3).

South Africa's higher education institutions have been described as low participation, high attrition systems (Cloete 2014:1358), where participation refers to the percentage of 20-24 year olds of the general population enrolled in higher education (Council on Higher Education, 2018: iv). Although the enrolment gap has been narrowed across race groups, the poor level of education for most individuals has remained. The Department of Higher Education and Training's report for 2019 showed that the annual average undergraduate graduation rate, between 2009 and 2017, has been 16.43%, falling below the national minimum target of 25% (Tewari and Ilesanmi 2020:4). This is thought to be due to the need to correct past injustices brought on by the apartheid era, and the increased tertiary education enrolment of previously disadvantaged students from schools of limited resources (Bozalek and Boughey 2012:688). This reiterates that although increased access is a key component in the transformation of higher education in South Africa, strategies must be formed to ensure that this participation overcomes the articulation gap and culminates in a successful outcome (Tewari and Ilesanmi 2020:13).

The Council of Higher Education's annual report for 2016 provides the most recently published participation rates. Since 2000, the participation rate for black students has increased from 14% in 2011 to 16% in 2016, and while the participation rate for white students decreased from 57% in 2011 to 50% in 2016

(Council on Higher Education 2018:6). This is shown in **Figure 1.1**. However, when looking at participation rate it is important to consider population growth.

Head counts for 2011 showed that there were 640 442 black students and 177 365 white students. In 2016, this rose by 8.7% to 701 482 black students and declined by 14% to 152 489 white students.

The report also showed that the number of males and females enrolled in tertiary education both increased from 2011 to 2016, with female enrolment increasing by 4.5% to 567 199 and male enrolment increasing by 3.4% to 408 697 (Council on Higher Education 2018:6).

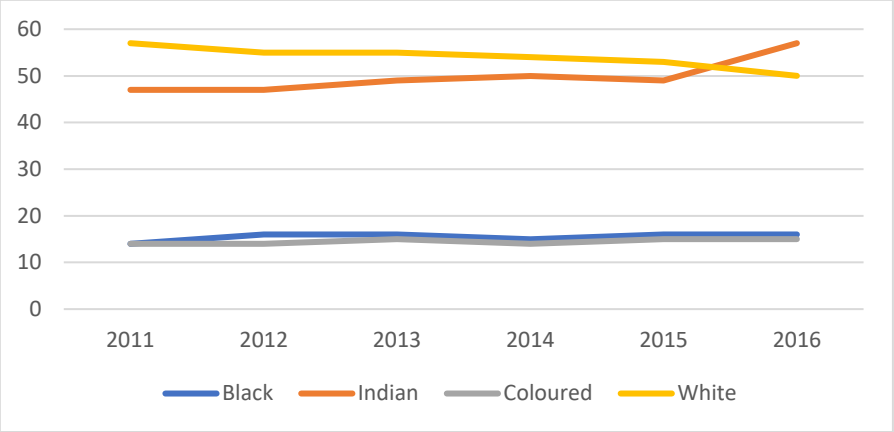

Figure 1.1: Participation rate by race 2011-2016

The success rates per qualification level by race has remained much the same from 2011 to 2016, with the success rates of black students being 77% (undergraduate) and 66% (postgraduate) in 2016, compared to 74% and 66% in 2011, and white students being 86% (undergraduate) and 81% (postgraduate), compared to 84% and 81% respectively.

The course success rates per qualification by gender also showed to be indifferent for females, with their success rates being 81% (undergraduate) and 72% (postgraduate), compared to 78% and 73%, and males being 76% (undergraduate) and 68% (postgraduate), compared to 73% and 68% respectively (Council on Higher Education 2018:14).

The average minimum time to pass the final chiropractic examinations is five to six years. In a study to determine why previously registered chiropractic students dropped out of the programme, Buthelezi (2018:42) identified the major reasons as financial constraints; post-course employment opportunities; personal factors, such as health and pregnancy; course-related factors and socio-cultural factors. Those course-related factors included the duration of time to study chiropractic; the workload of the programme; the programme content; shortages of resources (such as mentors and off campus access to technology); challenges related to the foundation programme, and learning, teaching and assessment techniques. A suggestion emerging from this study was that a variety of teaching and assessment strategies should be used (Buthelezi 2018:51).

South African universities need to strive to achieve higher knowledge productivity units, throughput, graduation and participation rates. Although improvements have been made in South Africa's educations systems, the absence of an enabling environment which provides every student the platform to express themselves and to reach their full potential, often does not allow for innovation. Lifelong learning should be promoted to allow for further education (National Planning Commission 2013:271).

Current research has shown that students' learning styles do have an impact on their academic achievement, and therefore graduation rates (Mckenna, Copnell, Butler and Lau 2018:280). Identifying the learning style preferences of the chiropractic students at the DUT and determining the relationship with their academic performance may help identify barriers to education and enhance the learning experiences of the students. This in turn may improve the rate of completion of the chiropractic students at DUT.

1.3 AIM OF THE STUDY

The aim of the study is to determine the learning style preferences of registered chiropractic students at the Durban University of Technology, KwaZulu-Natal, South Africa, and to determine the relationship of these preferences to the

demographics of the students and their academic performance. The focus was on the following objectives:

- What are the learning style preferences of chiropractic students in years two to six?
- What are the demographics of these students in terms of year of study, gender and age?
- Is there a correlation between the learning style preferences of the chiropractic students and their academic performance for the examination period of 2019?

Recommendations will be made based on the above findings to the department to be incorporated into the new curriculum thereby improving the classroom experience and possibly improving the academic results of the students.

1.4 DESCRIPTION OF THE RESEARCH SITE

This study took place at DUT, a university of technology in the eThekwini municipality, KwaZulu-Natal, South Africa, and accessed the learning style preferences of the chiropractic students that were registered in first to fifth years in 2019 at DUT. These students were required to have been registered for at least one subject for which they completed the final examinations in 2019. The table below illustrates which subjects these students would be required to have been registered for in 2019.

Table 1.1: Registered subjects for the study period of 2019

Year of Study 2019	Registered Subjects
1st	Chiropractic Principles and Practice I and Anatomy I
2nd	Topographic anatomy and Radiology, and Anatomy II
3rd	Diagnostics III and Chiropractic Principles and Practice III
4th	Diagnostics IV and Clinical Chiropractic IV
5th	Chiropractic Principles and Practice V, and Clinical Chiropractic V

These subject combinations allow for the best comparison amongst the years as they all contain clear practical and theoretical components that are chiropractic profession specific.

1.5 OVERVIEW OF THE DISSERTATION

This dissertation consists of six chapters.

Chapter 2 discusses the literature that gave rise to this study, including the history of education in South Africa; a description of a university of technology; the definition of and different types of learning styles; the advantages of identifying one's learning style preferences; teaching styles; the matched versus mismatched debate; the effect of age and gender on learning style preferences, and the current research available on learning styles and health sciences, utilizing VARK.

Chapter 3 outlines the methodology and research approach employed during this study. This consists of the research's aims, objectives and design; a description of the research site and the respondents; the methods utilized for data collection and a description of tests utilized for data analysis.

Chapter 4 presents the study's findings and data which was analysed to determine whether there was a relationship between the learning style preferences and the demographics of the students, and their academic results.

Chapter 5 consists of a discussion of the results and makes recommendations for the curriculum. The limitations of the research study is also presented.

Chapter 6 concludes this study and makes recommendations for future research in chiropractic education.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter includes the history of education in South Africa, a description of a University of Technology (UoT), the definition of and different types of learning styles, the advantages of identifying one's learning style preferences, and teaching styles. The chapter also explores the matched versus mismatched debate and the effect of age and gender on learning style preferences. Lastly, the current research available on learning styles and health sciences, utilising the Visual, Aural, Read/write and Kinaesthetic (VARK) questionnaire.

2.2 TERTIARY EDUCATION IN SOUTH AFRICA

There are many factors that could influence South African university students' pass rates, and much of the problem may be attributed to the rising trend of National Senior Certificate (NSC) grade inflation (Tewari and Ilesanmi 2020:6). This trend is the result of the pressure to deliver a better pass rate, rather than the improved quality of the pass. This presents itself in many forms, such as a low pass requirement (for three subjects, a requirement of 40% and another three subjects of 30%), the setting the examinations to a lower standard of difficulty to cater for those students of lesser ability (who are frequently socio-economically disadvantaged), and generous marking, allowing the perception of greater matric achievement (Tewari and Ilesanmi 2020:6).

Disadvantaged students are still commonly found in the designated 'Bantustans' formed during the apartheid era, where populations were segregated according to race (Chisolm 2012:85). Pienaar and McKay (2014:101) found that these areas remain amongst the poorest in the country, with a strong relationship still existing between the old apartheid geographical zoning and resources provided to schools.

In the province of Gauteng, South Africa, schools can manage admissions through geographical zoning, which often conform to the prior apartheid

Bantustans (Bell and McKay 2011:36). This management of student admission results in parents not only having to be able to pay fees but also forces them to relocate or commute to a former white area to receive quality education. It is for this reason that quality of education is now more driven by a class division, rather than a race division alone, and those of lower socio-economic status may be forced to enrol in poorly resourced schools (Pienaar and McKay 2014:102).

The township schools, which individuals of a lower socio-economic status are forced to attend, remain untransformed despite the massive allocations of funding by the government. These schools are often characterised by fewer and less qualified teachers, little access to resources, such as libraries, and poor school management systems (Pienaar and McKay 2014:103).

Lowering the standard of difficulty of the NSC for those of lesser ability may result in poor academic literacy skills developed in the primary and secondary levels of education (Jordaan and Moonsamy 2015:104-108). This inadequacy results in students being unable to meet the requirements of tertiary education, which may account for the low graduation rates of students at universities in South Africa (DHET 2018:23).

In a study on Speech-Language Pathologists at the University of Witswatersrand, South Africa, Jordaan and Moonsamy (2015:104-108) confirmed that academic literacy skills predict exam performance and therefore academic success. Academic literacy is the ability to determine the meaning of texts and to discern relevant from irrelevant information (Jordaan and Moonsamy 2015:99). Many students, however, find difficulty in this, especially in a multilingual country such as South Africa, where many students are learning through a second language.

Evidence suggests that many South African schools are failing in preparing students for tertiary education (Jackson 2016:15). As part of the 1994 redress of the academic system, many students who were previously excluded from quality education based on their race, enrolled into higher education, which resulted in large classes in most introductory modules (Tewari and Ilesanmi 2020:7). The staff-student ratio across the universities of South Africa are higher than that of the national target of twenty students per lecturer (Tewari and Ilesanmi 2020:7).

Figure 2.1 shows that in 2016 traditional universities are closest to this figure (22 students per lecturer), while universities of technology are well above the desired amount (28 students per lecturer). Large undergraduate classrooms are commonly made up of students with diverse levels of educational and linguistic backgrounds, which further adds to the resultant poor student performance (Fisher and Scott 2011c:30).

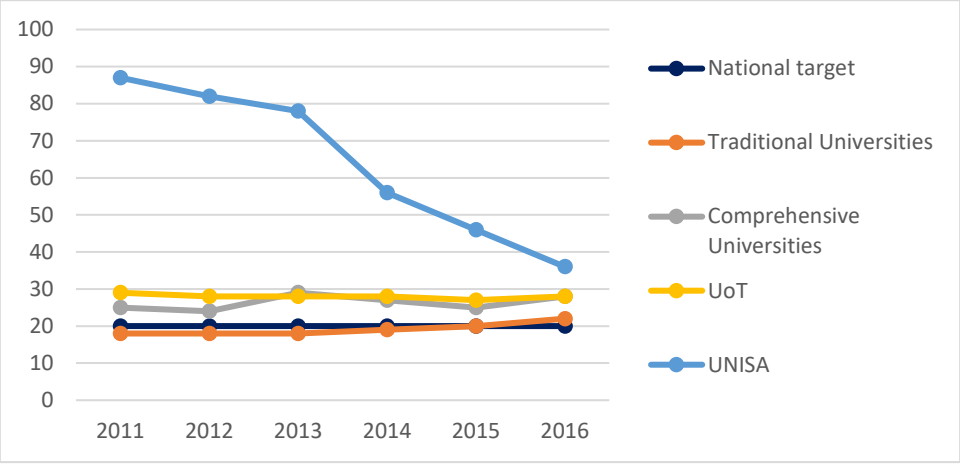

Figure 2.1: Student-staff ratios 2011-2016

The quality of the education system cannot exceed the quality of its lecturers and therefore the quality of staff greatly affects the academic performance of students (Tewari and Ilesanmi 2020:8). In 2011, the permanent academic staff at public South African universities comprised of 5799 Master's degree (34.2%) and 6346 doctoral lecturers (37.5%). In 2016, it comprised of 6838 Master's (35.6%) and 8627 doctoral lecturers (44.9%). However, it must be noted that the temporary academic staff well exceeds the number of permanent academic staff (Council on Higher Education 2018:46).

2.3 UNIVERSITIES OF TECHNOLOGY

South Africa has had three different types of tertiary education institutions (Badsha and Cloete 2011:14). Prior to 2002 there was a distinction between "technikons" and universities (Bozalek and Boughey 2012:14), after which mergers began to reduce the number of universities and to create two new types

of universities, viz. traditional universities (TU) and universities of technology (UoT) (Badsha and Cloete 2011:14). Because of this, the differences between a UoT and a TU, but also a technikon and a UoT must be defined.

The objective of a UoT is to provide general workplace preparation but with a strong sense of community and a high value on research (Garraway and Winberg 2019:39). Professor Mthembu, the current Vice-Chancellor and Principal at the Durban University of Technology, assisted in describing the characteristics of a UoT which differentiates it from a TU. The attributes of a UoT graduate are to become specifically prepared for their future role in the workplace, with professional, rather than generic competencies (Mthembu, Orkin and Gering 2012:216). The learning environment and student experience at a UoT typically differs as there is a greater utilization of technology in teaching techniques and when working amongst peers. A UoT views professional experience, the involvement of part timers and partnerships, as of a great importance. The need of staff with a dual identity, i.e. academics who have also thrived in an entrepreneurial and or industrial position, was emphasized (Mthembu *et al.* 2012:217). It was also noted by Garraway and Winberg (2019:39) that programmes offered by a UoT are typically knowledge-based, as compared to the theoretical principles offered by a TU.

The Durban University of Technology was founded in 2002 as a result of the merger of ML Sultan Technikon and Technikon Natal, and it is ranked among the top five universities of South Africa by the Times Higher Education World University Rankings in 2021 (World University Rankings 2021). The institution's performance was measured according to five criteria. These include teaching, research, citations, knowledge transfer and international outlook. DUT was placed 401 out of over 1500 universities across 93 countries. This ranking showcased areas in which DUT excelled in, such as research or citations, for which DUT placed 10th globally (Craig 2020).

The Council on Higher Education report for 2016 showed that there has been an increase in enrolments at both TU and UoT from 2011 to 2016, with TU enrolments increasing by 9.9% and UoT increasing by 10.5%. Graduation rates

have also increased for TU by 15% and UoT by 20% (Council on Higher Education 2018:33-36). Unfortunately, more recent data relating to Higher Education in South Africa has not been made available.

The first chiropractic students were admitted into the first South African chiropractic programme in January 1989, after a long fight with the Department of Health about the legitimacy, scope and safety of the profession (Till 2018:4-6). Due to the government policy that all vocational programmes be offered at technikons, it was decided that the programme be offered at Technikon Natal, which later became DUT (Till 2018:4-6).

Prior to the opening on the chiropractic programme, the chiropractic registers had been closed for 13 years, resulting in only about 100 remaining practicing professionals (Till 2018:4-6). These professionals believed it therefore best to visit a variety of countries to fill their gaps in the developments in education, research and standard setting, ultimately resulting in a draft curriculum for the chiropractic programme (Till 2018:4-6).

As chiropractors were working towards developing a recognised profession amongst osteopaths, homeopaths, naturopaths and herbalists, they felt it unlikely that the Department of Education would establish five new educational programmes (Till 2018:4-6). Therefore, it was decided to merge the programmes into two umbrella names viz. chiropractic (incorporating osteopathy and elements of naturopathy), and homeopathy (incorporating herbalism and elements of naturopathy) (Till 2018:4-6).

2.4 TEACHING AND LEARNING IN CHIROPRACTIC

In the last 125 years chiropractic has evolved from a full alternative medicine concept to now be part of complementary medicine and is considered to be primary health care (Walker 2016:1). Manual therapies utilized for the treatment of musculoskeletal pain were traditionally taught by way of knowledge being passed from parent to child or master to apprentice (Walker 2016:1). Within many countries there is registration and licencing available for chiropractors, with some

graduating from private colleges and a smaller amount from government-funded universities, and many having educational programmes of varying standards.

Walker (2016:2) discussed a 10-point plan to fully legitimise the chiropractic profession, of which improving pre-professional chiropractic education was at number one. He insisted that chiropractic education should be conducted at government-funded universities as they adhere to evidence-based teaching and learning, and their academic staff are required to be active in research. Walker also recommended that the faculty members in a chiropractic department should comprise of multidisciplinary health professionals so that the most experienced teachers would be available to teach that content (Walker 2016:3).

When reviewing literature on teaching and learning amongst chiropractic students, the results are in favour of a more diverse learning approach (Jarett-Thelwell *et al*. 2019; Fong *et al*. 2020; Guagliardo and Hoiriis 2013), and suggest that study strategies may be a predictor in performance outcomes (Schutz, Dalton and Tepe 2011, 2013).

Jarrett-Thelwell *et al.* (2019:22-25), at a New York chiropractic college, conducted a study on chiropractic students to compare student performance and student satisfaction ratings for an extremity radiology course taught using two different educational methods. The traditional method involved an introduction of the regional anatomy, followed by working in small groups, analysing the images at the viewing boxes, and homework exercises. The integrated method combined the traditional approach with computer-aided learning tools. These tools included interactive digital radiography modules for identification of normal anatomy, mensuration procedures, case studies, and computer-based self-assessment tutorials. The study found that student performance was similar for the integrative and traditional approaches but that the integrative approach allowed for more consistent student performance. The students, however, reported greater satisfaction with the integrative approach, as opposed to the traditional approach, citing improved learning in the former approach as their reason.

In a similar study, Fong *et al.* (2020: 1-7) determined the effect of online video learning aids on Australian postgraduate chiropractic students' objective

structured clinical examination (OSCE) results. They found that the addition of online procedural videos to standard learning had a small but positive effect on the students' performance in the OSCE.

Guagliardo and Hoiriis (2013:1-7) explored the use of an active learning component in lessons. They too found that the inclusion of the active learning component was more beneficial and helped improve academic performance.

Schutz, Gallagher and Tepe (2011:8-9), in a cross-sectional study utilizing the Learning and Study Strategies Inventory (LASSI), at a chiropractic college in England, determined that there were significant differences between the higher and lower performing chiropractic students in their learning and study strategies. They found no differences in cognitive activities between the higher and lower grade point average (GPA) groups, but the results for two factors, effort related activities and goal orientation, were much higher for the higher GPA group of students. This suggests that strategic learning is an important factor in academic success and that educational interventions and curriculum changes designed to improve this may allow for greater academic success of lower performing students.

Schutz, Dalton and Tepe (2013:5) also made use of LASSI subtests to predict the performance outcomes in the National Board of Chiropractic Examiners (NBCE) Part 1 examinations. A group of 69 first trimester chiropractic students from Missouri, USA, completed the LASSI subtests which were then utilized to predict low, medium or high examination results. Four of the LASSI subtests (Anxiety, Concentration, Selecting Main Ideas, Test Strategies), were significantly associated with NBCE examination levels, and Goal Orientation was found to be an important predicting factor in the overall mean NBCE examination performance.

Currently at the DUT, within the chiropractic programme, many teaching styles exist. Lectures are delivered aurally by the lecturer, aided by slideshows from a data projector, copies of the notes or articles, and textbooks. The practical elements of the course are comprised of classroom demonstrations, anatomical dissections, the use of anatomical models and clinical practice. This type of

instruction is classified as multimodal and kinaesthetic, respectively. The assessments comprise of written examinations and practical examinations, including identifying anatomy on a cadaver assimilated practicals and Objective Structured Clinical Examinations (OSCE) (Dept. of Chiropractic 2019:28-44). The assessments can be classified as Read/write and Aural (writing), Visual and Aural (vivas), Kinaesthetic (mock patients) and Multimodal (OSCE).

The subjects chosen for this investigation are shown in **Table 2.1**, and were according to year in the chiropractic programme, as per the Chiropractic 2019 Handbook. These subjects represent the chiropractic programme as they comprise of theory and practical elements, making them very dynamic. The subject Gross Anatomy is the study of human anatomy which is explored in theory lectures and through anatomical dissections. Diagnostics consists of information regarding the symptoms, mechanism, diagnostic examination, and treatment of the pathology. The subject Topographical and Radiological Anatomy includes the identification of anatomical surface landmarks, the palpation of the vital organs and musculoskeletal system, and identification of the structures on an x-ray. Chiropractic Principles and Practice consists of information relating directly to the profession, such as the theory and application of spinal manipulative therapy and soft tissue techniques, and chiropractic philosophy. Clinical chiropractic consists of management rationale, clinical radiology and considerations in chiropractic patient care (Dept. of Chiropractic 2019:28-44).

Table 2.1: Registered subjects chosen for investigation for the academic period of 2019

Year of Study 2019	Registered Subjects
1st	Topographic and Radiographic Anatomy I, and Gross Anatomy I
2nd	Topographic Anatomy and Radiographic Anatomy II, and Gross Anatomy II
3rd	Diagnostics III and Chiropractic Principles and Practice III
4th	Diagnostics IV and Clinical Chiropractic IV
5th	Chiropractic Principles and Practice V, and Clinical Chiropractic V

2.5 LEARNING AND LEARNING STYLE PREFERENCES

Cognition has been described as the study of how people retrieve, encode, structure, store, use or otherwise acquire knowledge (Lutz and Huitt 2003:1). One of the primary areas of cognition studied by researchers is memory. The information processing theory views memory as a multi-staged, discontinuous system of connections that allows individuals the ability to interpret the perceptual world so that they may develop responses to changes how they observe (Lutz and Huitt 2003:1).

Lutz and Huitt (2003:4) described the learning process as when relatively permanent changes occur. There are many models that describe three ways in which retention takes place. Firstly, if a stimulus is almost an exact match, then the new stimuli would simply be added to the mental representation, with no change to the structure. Secondly, if the new stimulus does not match the existing mental representation, fundamental changes must take place to allow for the addition of characteristics and broadening of knowledge to occur. Thirdly, if the stimulus varied greatly from the existing structure, then a new structure that stands alone would be created and would be linked to its existing relevant structures. Therefore, when learning, the information must be presented in such a way that it can be incorporated into the memory structure.

Atkinson and Shiffrin (1968: 115-118) developed the foundation for the most widely used model of information processing, the stage theory model. The stage theory model describes sensory memory as the first step in stimuli perception and it has been identified that there seems to be a different section for each type of sensual perception, with each individual having their own preferences or limitations. This is an important factor because stimuli that are not sensed cannot be further processed and will not be incorporated into a memory that can be recalled. From sensory memory, the information is transferred to short-term memory, and then to long-term memory, where the existing structure is adapted to allow for new knowledge (Lutz and Huitt 2003:5). Therefore, for the student to process the initial stimuli, there must be a compatibility of their learning style and the delivery of information (Wilson 2011:2), and once this stimulus is processed,

relatively permanent changes need to occur for that new information to be integrated into the student's long-term memory.

Schutz *et al.* (2011:5) expounded that understanding the relationship between learning styles and academic performance could help identify barriers to learning and allow for interventions so that the students' learning experience may be improved. Whillier *et al.* (2014: 21) described learning styles as the method in which individuals gather, process, interpret, organise and think about new material or gain skills. These learning styles are influenced by the individual's thoughts, behaviours, attitudes, motivation and beliefs (Schutz *et al.* 2011:5). It has also been determined that learning style preferences are influenced by peers, technology and cultural background (Alkooheji and Al-Hattami 2018:50).

The tools that are utilized to determine one's learning styles are based on four models, namely personality (e.g., introvert versus extrovert), information processing (e.g., sequential versus holistic), social interaction (e.g., avoidant versus participant; competitive versus collaborative), and instructional preferences (through which medium individuals best acquire knowledge) (James, D'Amore and Thomas 2011:418).

There are many learning style questionnaires that exist: the Kolb Learning Style Inventory (LSI), the Learning Preference Inventory, the Honey and Mumford Learning Style Questionnaire (LSQ), Myers-Briggs Type Indicator, the Learning and Study Strategies Inventory (LASSI), the Learning Styles Profiler (LSP) and Fleming's Visual, Aural, Read/write, Kinaesthetic (VARK) inventory (Whillier *et al.* 2014:21). Neil Fleming's VARK learning style preference questionnaire was selected for this study.

2.6 THE VARK MODEL

The Visual, Aural, Read/write and Kinaesthetic (VARK) model is a learning style inventory based on the information processing theory (Whillier *et al.* 2014: 21). It was developed from the earlier literature on neurolinguistic programming and focuses on the different ways in which learners acquire, assimilate and apply information, and is easily administered. The questionnaire was designed to

identify the preferences of students for particular modes of information presentation so that learning strategies can be tailored for students (Fleming 1995:1-2). The VARK model is made up of 16 questions which are divided into four focused areas: personality traits, information processing, social interaction and instructional preferences (Fleming 1995: 1-2). It highlights the four sensory modalities that can be measured, namely Visual, Aural, Read/write and Kinaesthetic (VARK) learning.

Visual learning describes having information presented to the students in the form of flow charts or enhanced by graphics (e.g., the use of a PowerPoint displays in class). Aural learning describes a preference of hearing others or even themselves speak (e.g., listening to the lecturer explain a concept). Read and write learning describes the systematic process of reading, remembering, and rewriting information (e.g., rote learning in the form of repetition). Kinaesthetic learning incorporates many sensory modalities, preferring learning by doing or real-life examples (e.g., the incorporation of a practical component or model into a lecture). However, learners are not limited to one learning style and can be categorized as unimodal or multimodal (bimodal, trimodal or quadmodal) in their learning preferences (Fleming 1995:310).

Students who display a unimodal learning style preference will be limited to needing the information presented to them in their preferred form for understanding to occur. Those who are multimodal in their learning style preferences may sometimes take longer to understand the content as they usually require the information to be presented in more than one form (sometimes having to utilize all four modes of learning). However, the advantage of the student being multimodal in their learning style preferences is that they can apply the mode that is most suitable for the given context (Ally 2010: 19).

All sensory modalities are important intelligences for health professionals to possess and utilize in practice (Ally 2010:17). Through visual learning, the student can examine the patient for signs and symptoms so that a diagnosis may be made. Through aural learning, student can discuss conditions and patient management with peers and colleagues, and by applying reading and writing the

student can write structured patient reports. “Hands on” or kinaesthetic learning is especially utilized in the chiropractic profession during treatments (manipulation), writing management plans and through analysing x-rays.

The VARK learning style inventory was chosen for this study as it not only identifies the learning style preferences of the students but provides learning strategies that can be adopted by the students and a variety of teaching strategies that may be used to enhance the learning process. The VARK questionnaire may be accessed at https://vark-learn.com/the-vark-questionnaire/ and is accessed by students and professionals of different expertises all around the world. The VARK database stores the VARK results, as well as the demographics of each respondent and was last updated in 2017. Also available on the website are study strategies suggested by Neil Fleming specific to each mode of study.

2.7 ADVANTAGES AND DISADVANTAGES OF RECOGNISING STUDENTS’ LEARNING STYLES

Samarakoon *et al.* (2013:1) recognised that it is a challenge to impart a large amount of knowledge within a small time so that it is retained, can be recalled and is able to be interpreted. Knowledge of learning styles could be useful because through this the students may be empowered to identify and utilize the techniques that are best suited to them so that their education may be enhanced. Lecturers may develop solutions to students’ learning style problems and motivate the students to become life-long learners (Ally 2010:20).

Current research suggests that there is a correlation between learning styles, clinical experience and success in examinations (Samarakoon *et al.* 2013:1). The identification of one’s learning style may assist academic staff in personalizing and improving student learning, especially in those who are classified as “at risk” students (Wilson 2011:27, 49). A discussion of learning styles must occur in classrooms so that students may become aware of the variety of learning style preferences and realise that they may be in fact “different; not dumb” (Fleming 1995:1). Such discovery could set them on the path to exploring alternate

strategies better fit to their preferences and thereby bringing about increased understanding and improved performance (Wilson 2011:27).

Fleming (1995:1) recognised that there is no best way to teach but those who cater for the different needs of the students show better results. It is therefore vital for the lecturers who design the teaching strategies and curriculum to accommodate diverse learning styles. Raja and Priyadarshini (2018: 268) wrote that identifying and matching the students' learning style preferences may motivate and empower them, but one should avoid labelling them as a particular type of learner. Further criticism has been provided by Li *et al.* (2016:91), who believed that learning styles could label students, resulting in limiting their potential for learning. They added that learning styles have been over-popularised resulting in misleading terms, and that too much research into learning styles has been performed, while education resources would be better spent in other fields to guide teaching and learning. Newton and Miah (2017:5-7) wrote that students' do have preferences for how they learn, but the theory of learning styles is conceptually flawed as it does not account of the complexity of understanding; some information cannot be demonstrated in a single style. Li *et al.* (2016:92) did conclude, however, that one cannot currently appropriately deny the importance of learning styles in a practical context.

2.8 TEACHING STYLES

There has been increasing interest into the study of learning styles and assessment methods by education professionals, sparked by the desire to personalize and improve student learning (Wilson 2011:27). Teaching is no longer just the process of transferring information. Previously, if a student struggled to absorb the information presented to them, they were regarded as lazy or unmotivated (Ally 2010:22). This has resulted in great changes in education.

The recognition of the diversity of learning styles and the ever-changing characteristics of university students has forced educators to incorporate a variety of teaching tools and assessment techniques to support the learning

process (O'Mahony *et al.* 2016:1). In the field of medical education, there has been a shift from the didactic teacher-centred and subject-based teaching to an interactive and student-centred method of teaching (Samarakoon *et al.* 2013:1). Evans, Ozdalga and Ahuja's (2016:382) research into medical generational learning noted that to be effective, "*teaching styles have to take into account learning styles*".

A few of the wide range of instructional approaches are discussed below (Wilson 2011:30-36):

Teacher-centred or didactic instruction

This style includes teaching strategies, such as a teacher presenting a lecture or performing a demonstration, or students copying the teacher's notes. During this type of instruction, the teacher holds the authority and is responsible for imparting the information to the students.

Instructional model approaches

Several instructional models have developed out of the idea that there is a need for instruction other than teacher-centred approaches. This addresses the variation in the students' learning needs and allows for more interaction and evaluation.

Constructivism

In attempt to move away from the teacher-centred approach towards the learner-centred approach, there has been significant interest in the constructivist approach to education. The main principle of this theory is that learners develop knowledge through exploration and are continuously constructing and reconstructing meaning with each new encounter. Constructivism focuses on diversity in experiences and the individuality of learners.

Experiential instruction

The goal of this method of instruction is to simulate real life experiences that engage the students mentally and emotionally so that they may relate personally to the presented information. This theory not only focuses on the hands-on aspect of constructivism but also the mental aspect of reflection and conceptualization.

Brain-based teaching

This theory focuses on neurological and cognitive science and has been receiving increasing attention for recognising that the physiology and organization of the brain have practical implications for education. It looks to the three interconnected components, the r-complex, limbic system and neocortex, each playing a distinct role in learning and functioning.

Differentiated instruction

This type of instruction refers to the process of incorporating a variety of approaches and strategies in instruction, practice and assessment. Differentiation allows for students to utilize their individual styles and preferences to maximise their learning strengths and achieve academic success.

2.9 MATCHED VERSUS MISMATCHED

There is an ongoing debate about the importance of matching learning style preferences with teaching styles and their effects on student performance. Some educators claim that unmatched learning styles could result in students becoming bored, inattentive in class, performing poorly in their academics and possibly withdrawing from their academic programme (Jackson 2016:37). This is the reason for the advocation of tailoring instruction and teaching styles to students' learning style preferences (Wilson 2011:40).

Ally (2010:53), in an investigation of first year anatomy students, found that those students whose learning styles matched the teaching and assessment styles for the aural and read/write category, and for the aural and visual category performed better than those whose preferences were mismatched. However, for the Visual, Aural and Read/write category this was the converse.

Schutz *et al*. (2011:8) advocated catering for the preferences of the chiropractic students in their study in the United States of America. Similarly, in Gilakjani's (2012) review of the literature, he wrote that attempting to provide different learning styles may help learners achieve better results and that teachers should develop teaching methods that correspond to their students' learning style

preferences. He further explained that when mismatches do happen the student may become bored, inattentive and perform badly in tests, resulting in them dropping out (Gilakjani 2012:54-56). Students whose learning styles are unmatched with the mode of instruction may not perform well academically and possibly lack the confidence and interest to persevere and make the necessary effort to improve their learning (Wilson 2011:41).

Others believe that there is insufficient evidence supporting the benefits of matching learning styles to students and that students need to experience multimodal teaching styles that are cognisant of the subject matter as well (Ally 2010:21). Advocates against the matching theory include Kirschner (2017:170) and Papanagnou *et al.* (2016:6). Kirschner (2017:170) wrote that it is unknown to which degree learning styles can be matched with teaching methods so that there can be any benefits in learning. Learning style inventories have not been shown to be reliable and, therefore, there is no point in matching the students' learning style preferences with teaching styles. Papanagnou (2016:6) found that, while matching teaching styles with learning style preferences in medical students resulted in greater student satisfaction, there was little effect on actual procedural outcomes.

2.10 AGE AND LEARNING STYLE PREFERENCES

Generation Z (Gen Z), those born between 1996 and 2012, have begun to enter universities and the workplace. They are said to have similar characteristics to Generation Y, those born between 1981 and 1995 but also possess some avid differences (Chicca and Shellenbarger 2018:180). Chicca and Shellenbarger (2018:180) wrote that frequent technology use by Gen Z has led those learners to have limited attention spans and to be bored easily when presented with monotony and repetition. These students desire practical and relevant information presented to them in an individualised manner. It has therefore been suggested that the classroom needs to be shifted from teacher-disseminated information to learner-centred multidimensional approaches (Chicca and Shellenbarger 2018:181).

Students of Generation Y, also known as millennials, began enrolling in tertiary education from the early 2000s (Simpson and Richards 2015:5). They are said to be culturally diverse, risk-takers, self-reliant and technologically advanced, and are hungry for information (Simpson and Richards 2015:5). In contrast, Generation X, those born between 1961 and 1981, who have been present in the classroom for the last twenty years and make up the majority of academic staff members, are described as problem solvers and multi-taskers and they focus on outcomes and not necessarily the learning process. It is necessary to investigate the learning style preferences of the student intake as learning styles are influenced by the generation's thoughts, behaviours, attitudes, motivation and beliefs (Schutz, Gallagher and Tepe 2011:5), which have been shown to differ in each generation (DiLullo, McGee and Kriebel 2011:2019).

DiLullo, McGee and Kriebel (2011:215) found that millennials may be described as needy for feedback, impatient for response and that they desire flexibility, often preferring to work in small groups and make use of technology. These characteristics may have negative implications on students who make up large classes where time for informality and interaction may be limited (Darabi, Macaskill and Reidy 2017:573).

Van Rhijn, Lero, Bridge and Fritz (2016:37-39) explored factors affecting the success of mature students at a Canadian university. These challenges included access to financial support, resources and flexible study options. Flexible study options are an important factor to consider when issuing group assignments as mature students often have multiple roles to fulfil and therefore limited time to meet and discuss a group assignment. A lack of recognition was also an issue pointed out in their study, with students feeling that their maturity and past experience are not being acknowledged. Kahu, Stephens, Leach and Zepke (2013:791) found that there is an influence of student engagement on student learning and satisfaction, and that mature students exceed their younger peers in terms of work-integrated learning and academic tasks. This suggests that, with the possible limited time available to mature students, greater satisfaction and academic success may be achieved if teaching material is relevant to the course outcome and relatable to the students' past experiences.

There are variations in how students learn within the different age groups (young, middle or late adulthood) due to the developmental tasks associated with that period (Ngala 2017:99). Older students tend to be more self-directed due to their many social responsibilities and apply learning material to the real world. Younger students experience a shift of responsibility as they enter tertiary education, thereby making the transition to self-directed learning (Ngala 2017:99).

Alkooheji and Al-Hattami (2018:50) determined that moderate differences in learning style preferences do exist in different age groups. In the first age group (16-18 years of age), their preference of visual and kinaesthetic learning was near equal, as was their preference for Read/write and Aural learning. In the second age group (19-21 years of age), kinaesthetic learning was the strongest learning preference, while in the third age group (22-24 years of age) visual learning was the most preferred preference. Reading/writing was the least preferred preference of the second and third age groups.

However, Ngala's study on adult learners in Kenya, and a study on first year nursing and mid-wifery students, concluded that there were marginal differences in learning style preferences and therefore warned against categorizing learners based on their age variable (Ngala 2017:105; James, D'Amore and Thomas 2011:419).

2.11 GENDER AND LEARNING STYLE PREFERENCES

Many studies have investigated the effect of gender on learning styles in health education and showed conflicting results. Soundariya *et al.* (2017:1022), in a study on medical students in India, found that there was no statistically significant association with gender and learning style modality. However, a trend was observed where more females were visual learners, and more males were more commonly kinaesthetic learners.

Almigbal (2015:351-352), in a study on medical students in Saudi Arabia, found that were significant differences in gender preference of learning styles, with females showing greater preferences for Visual only, Aural only, Read/write only, bimodal and all VARK methods. Males were found to be more unimodal

kinaesthetic than the females. Significant differences were also found by Khanal, Giri, Shah, Koirala and Rimal (2019: 349) and Ally (2010:59-60) in studies on anatomy students. In contrast, Khanal *et al.* (2019:349) found total Visual, Kinaesthetic and VARK scores were higher among males, while Aural and Read/write scores were higher among females. Ally (2010:59-60) found that while both males and females preferred multimodal learning, it was more preferred amongst females.

2.12 CURRENT RESEARCH ON LEARNING STYLES IN HEALTH SCIENCES UTILIZING VARK

It has become common for institutions to issue learning style assessments to incoming students so that they may assist them in determining which learning strategies would lead to an optimal achievement of knowledge (DiLullo, McGee and Kriebel 2011:219). The learning style preferences amongst students may reflect their personal experiences with a variety of learning environments, content of discipline and resources available to them (DiLullo, McGee and Kriebel 2011:219). Recent research revealed diversity within the millennial student sub-populations, and it is conceivable that there may be unique learning style preferences specific to students within each healthcare profession (DiLullo, McGee and Kriebel 2011:219).

Whillier *et al.* (2014:21-27) added to the limited literature available on chiropractic learning style preferences with their study conducted at a chiropractic university in Australia. Utilizing the Visual, Aural Read/write and Kinaesthetic (VARK) questionnaire, they determined that 56% of their students were multimodal and 44% were unimodal learners, with students having the highest compatibility for kinaesthetic learning and lowest for read/write learning (Whillier *et al.* 2014:23-24). Whilier *et al.* (2014:26) stated that the generalizability of these results is limited due to the study being performed at a single institution and therefore cannot be expected to be the same at universities of other geographical or cultural settings. This highlighted the need for the present study to be done.

Further investigations are shown in **Table 2.2**, which highlights the learning style preferences reported by previous studies and the VARK website. The table shows that the multimodal style of learning is the most preferred learning style with the exception of Almigbal (2015:351), Soundariya, Deepika and Kalaiselvan (2017:1022) and Hlousek and Krause (2019: 1). The individual sensory preferences varied in the performed studies with kinaesthetic learning being highest for VARK (2020), Ally (2010:42), Khanal *et al.* (2019: 348) and Hlousek and Krause (2019:1), and visual learning for Almigbal (2015:352) and Soundariya *et al.* (2017: 1023).

Table 2.2: The learning style preferences of medical and allied health students recorded by previous studies

STUDY	Study population	Sample size (*n*)	Multi/ unimodal	V	A	R	K
VARK 2020	VARK website	170 653	64% Multimodal 36% Unimodal	1.9%	5.1%	4.2%	22.8%
Ally 2010:1-96	Anatomy students, South Africa	68	64% Multimodal 36% Unimodal	6%	1%	13%	15%
Khanal *et al.* 2019: 234-355	Anatomy students, Nepal	142	53.52% Multimodal 46.48% Unimodal	1.4%	14.8%	0.7%	29.6%
Almigbal 2015:349-355	Medical students, Saudi Arabia	600	46.2% Multimodal 53.8% Unimodal	16.2%	21.2%	5.7%	10.7%
Soundariya *et al.* 2017: 1020-1025	Medical students, India	121	46.2% Multimodal 53.8% Unimodal	24.1%	17.5%	1.67%	10.8%
Hlousek and Krause 2019: 1	Anatomy students, USA	165	37.8% Multimodal 62.2% Unimodal	14.3%	11.2%	5.1%	31.6%

While many investigations have been conducted to understand the relationship between students' learning styles and their academic success, the literature reflects conflicting results. Almigbal (2015:354) and Khanal *et al.* (2019: 351) reported no correlation between the students' VARK results and academic success. Conversely, Schutz *et al.* (2011:8-9), in a cross-sectional study at a chiropractic college in England, and Ally (2010:41-53) described observable relationships between the students' learning preferences and academic success.

Investigations performed at institutions outside of South Africa may not be applicable as the socio-economic factors in South Africa differ in terms of wealth distribution amongst demographic groups, home language and cultural normalities (van Aardt 2011:9-13). There is a paucity of research specific to learning style preferences and chiropractic education, with many of those studies not being applicable to a university of technology in South Africa.

Besides these limitations, Ally (2010:1-96) assessed the performance of first year anatomy students (via mini assessments) when the teaching and assessment styles were matched with the students' learning styles. This present study will investigate the effect of the chiropractic students' learning styles on their overall performance in different assessment formats, not only in first year, but in the subsequent years.

The next chapter describes the methods used to determine the learning profiles of the chiropractic students and their correlation with their evaluated demographics and academic results.

CHAPTER 3 RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 2 discussed the current literature on the relationship between learning style preferences, demographics and academic results within the health sciences, specifically focusing on the chiropractic programme. This chapter presents the research design, research procedures, the research tool, the sampling process, ethical considerations and statistical analysis methods used in the study.

3.2 RESEARCH TYPE AND DESIGN

Research designs are categorized according to perspective and purpose. A correlation study, such as this, examines the phenomena that exist during the period of the study and consist of descriptive, predictive and model testing (Brink, van der Walt and van Rensburg 2018:9).

Brink, van der Walt and van Rensburg (2018: 20) described a research paradigm as a set of organised principles through which the researcher approaches and interprets reality. This study was conducted in a post-positivist paradigm as it set out to discover observable facts (Brink, van der Walt and van Rensburg 2018: 19).

The researcher employed a quantitative approach using the VARK learning style questionnaire, as well as a demographic questionnaire, the results of which were compared against the students' academic results, utilizing a statistical package. Quantitative research allows for data to be collected objectively and to be generalized to the population (Queirós, Faria and Almeida 2017:370).

3.3 ACCESS TO SITE AND ETHICAL CLEARANCE

The study was conducted on chiropractic students in a faculty of health sciences at a university of technology. Permission to conduct this study on university

premises was obtained from the institution's head of research (Appendix A). The head of departments of the Chiropractic Department and the Basic Medical Sciences were approached for the chiropractic students to serve as study respondents and for the use of their academic results (Appendix B). Permission was also sought from the lecturers for use of their class time (Appendix C). Permission to use the VARK learning style was obtained from the website designer and gatekeeper of the VARK website (Appendix D).

An ethical clearance for the research project (029/20) was obtained through the DUT Institutional Research Ethics Committee (IREC) and is included as Appendix E. Permission was sought from the institution to conduct the study and is included as Appendix F.

3.4 STUDY SETTING AND TARGET POPULATION

The target population included chiropractic students registered for a combination of subjects, as detailed in **Table 3.1** below. The subject combinations allowed for the best comparison amongst the years as they all contain clear practical and theory components that are chiropractic programme and profession specific. These students would be required to have been registered for the period 2019 to 2020 (inclusive).

Table 3.1: Subjects students were required to be registered

Year of Study 2019	Registered Subjects
1st	Topographic and Radiographic Anatomy, and Anatomy I (Gross Anatomy)
2nd	Topographic anatomy and Radiology, and Anatomy II (Gross and Clinical Anatomy)
3rd	Diagnostics III and Chiropractic Principles and Practice III
4th	Diagnostics IV and Clinical Chiropractic IV
5th	Chiropractic Principles and Practice V, and Clinical Chiropractic V

Due to the Covid-19 pandemic country-wide lockdown and the subsequent move to online learning, the initial method of data collection from students had to be

amended. Following IREC approval, the respondents received a link to the online survey on QuestionPro, where they had access to the questionnaire, as well as the necessary letters of information and informed consent. The respondents were provided with the researcher's contact details so that any misunderstandings may be clarified. Following the ease of lockdown regulations and the subsequent return of students to campus, a follow-up meeting was arranged between the researcher and the students. All students who were unable to access the online questionnaire, due to wi-fi and or data constraints, were given the opportunity to complete the questionnaire in a hard copy format.

The principles that constitute ethics, as stated by Brink, van der Walt and van Rensburg (2017:29), include autonomy, beneficence, non-maleficence and justice, which were adhered to during the study. The students were informed of the selection criteria used in the study, and that their participation in the study was voluntary, confidential and that they were free to withdraw at any time without prejudice, all of which ensured non-maleficence. A letter of information assured them that their data would be stored in a secure place that would only be available to the researcher and supervisors. Informed consent was then obtained (Appendices G and H, respectively).

The autonomous individual has the right to self-determination; therefore, participation was voluntary. The principle of beneficence was upheld during this questionnaire style study, which ensured the respondents' right to protection from harm and discomfort. The principle of justice assures that the participant had the right to fair selection privacy, anonymity and confidentiality and therefore all information related to the participant, their identity and their names were not disclosed. Whilst respondents' student numbers were recorded to allow correlation with their marks, this data were only accessible to the researcher, statistician and supervisors. All electronic information was password protected and stored on a USB at DUT and will be deleted after five years. All paper data were stored in locked cupboards and will be shredded after five years. This aligns with the Protection of Personal Information (POPI) Act, where written informed consent was obtained and all gathered information is accurate, de-identified, stored securely and then will be deleted after five years (Buys 2017:954-956).

The POPI Act speaks of the responsibility of the researcher with regards to lawful information processing, the rights of the data subject, personal information, recording of personal information and the responsible party (Buys 2017:954-956).

3.5 SELECTION OF RESPONDENTS

Sampling is the process through which a sample is extracted from a population (Mohsin 2016:11). The more the sample represents the population, the more generalizable the results are said to be. This study utilized purposive random sampling, a category of probability sampling. In probability sampling, every person who makes up the population has a known probability of being included in the sample and the population is precisely defined. This type of sampling reduces the chance of systematic errors, sampling biases, and the results are more generalizable to the population. When the population is approached while having a prior purpose in mind and has a predetermined criterion, it is termed purposive random sampling (Mohsin 2016:30).

There were 142 students registered with the chiropractic programme in 2020, during the time of data collection. Using purposive random sampling, and with the alpha coefficient = .05, and a margin of error of .05, the minimum sample required was calculated to be 104. This is broken down by year as shown in the **Table 3.2** (Esterhuizen 2020).

Table 3.2: Sample size of population

Year of study 2019	Population	Minimum sample
1st	41	30
2nd	36	26
3rd	20	15
4th	25	18
5th	20	15
	142	**104**

Inclusion Criteria:

Chiropractic students registered for the annual programme between second and sixth year in 2020 at DUT were the focus of this study. These students were required to have been registered for at least one subject, for which they completed the final examinations in 2019.

Exclusion Criteria:

The exclusion criteria for this study included:

- Students who did not sign the letter of informed consent.
- Students who did not write the necessary examinations in 2019.

3.6 DATA COLLECTION PROCESS

3.6.1 Aim 1

Determine the demographics of the chiropractic students in terms of age, gender, race and year of study

To determine the demographics and learning style preferences of the individual chiropractic students, respondents were asked to complete the questionnaire (Appendix I) which consisted of a section A (demographics) and a section B (the VARK questionnaire). The demographic questionnaire required respondents to provide their student number, age, gender, race and year of study. Questionnaires are typically completed anonymously; however, this would have provided a limitation in this study, as a comparison was drawn between the students' learning style preferences and their academic results.

The distribution of the questionnaire through an online platform, QuestionPro, was decided upon due to the Covid-19 pandemic, because students were not able to attend campus lectures. Links to the questionnaire were distributed to the students and the researcher's contact details were provided should they have had any questions regarding the study. The completed online questionnaire results automatically uploaded onto the online platform, where only the

researcher could view them. These results were then downloaded and saved onto a Microsoft Excel spreadsheet for data capturing purposes.

Once on-campus lectures had resumed, students who had not completed the online demographic questionnaire were given the opportunity to participate in the research study by completing the hard copy questionnaire. Hard copies were chosen because of the difficulty that would have been experienced correlating the available booking times of the computer lab with the students' timetable. The completed questionnaires were then collected, and the students' individual responses were entered into an Excel spreadsheet.

3.6.2 Aim 2

Determine the learning style preferences of these chiropractic students

3.6.2.1 The Measurement Tool

The VARK questionnaire, which is based on the information processing model, is made up of 16 questions and is divided into four focused areas: personality traits, information processing, social interaction and instructional preferences (Fleming 1995: 1-2). In the VARK questionnaire, specific answers indicate a specific learning style preference. For an example, when examining the question, *"You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?"*, from the VARK questionnaire (VARK 2019), a learner with a Visual preference would respond, *"It is a modern design and looks good"*, a learner with an Aural preference would respond, *"The salesperson telling me about its features"*, a learner with read/write preference would respond, *"Reading the details or checking its features online",* and a learner with a kinaesthetic preference would respond, *"Trying or testing it".*

The students were required to choose the option(s) that best suited the way they would have respond in each situation and could have even chosen not to answer the question if they did not understand or had not experienced the situation.

The VARK questionnaire was suitable for the purpose of this study as it focuses on the different ways in which learners acquire, assimilate and apply information, it is easily administered (Whillier *et al*. 2014: 21), and copyright permissions had been obtained (reference: VCP1007350, Appendix D). The manner in which the survey has been designed applies to both theoretical and practical knowledge, thus making it a suitable tool for measuring the learning style preferences in a programme such as chiropractic, due to its theory and practical components.

The validity and reliability of the survey was concluded by Leite, Svinicki and Shi (2010:1-18), where they subjected VARK to psychometric analyses. They collected data from the VARK website, belonging to students from the United States of America, who had completed the questionnaire for the first time. They determined that the four-factor correlated trait–correlated uniqueness (CTCU) model was a fit for the observed data and that the reliability estimates of the scores of VARK were adequate. The researcher did not adapt the questionnaire in anyway, and therefore a pilot study for the VARK questionnaire was not necessary.

3.6.2.2 Determining Student Learning Preferences

With permission from VARK, the researcher distributed the VARK questionnaire with the demographic questionnaire. The completed questionnaires were then collected, and the students' individual responses were captured in an Excel spreadsheet, which was then sent to VARK for analysis.

3.6.3 Aim 3

Determine if there is a correlation between the learning style preferences, demographical data and academic performance of the chiropractic students for the examination period of 2019

By utilising the student numbers provided on the completed questionnaires, the academic results for the year end 2019 were correlated with the students' learning style preferences. These results were provided by the faculty, with permission from DUT's Department of Management Information. The practical and theory components of each subject were recorded separately so that the relationship between the learning style preferences and each component could be investigated. A random number was assigned to the students' data to maintain confidentiality. The collected data were then tabulated before being sent to a statistician for analysis.

3.7 ANALYSIS OF RESULTS

The IBM Statistical Package for Social Sciences version 27 (SPSSv227) was used to analyse the data. One-way ANOVA tests were used to investigate the differences in academic results and students' learning style preferences. This was done for practical and theory results. Chi square tests or Fisher's exact tests were performed to compare the different distributions of learning style preferences by gender. One-way ANOVA tests were performed to compare the different distributions of learning style preferences by age. Non parametric Kruskal-Wallis tests were performed to compare the different distributions of learning style preferences by year of study. Significance was considered present at p-value <0.05 (Esterhuizen 2020).

The analysis of variance (ANOVA) is an extension of the t-test which uses variance to calculate a value that reflects differences between two or more means (Brink, van der Walt and van Rensburg 2017:176). Chi-squared tests are one of the most popular non-parametric statistical tests and are appropriate for comparing sets of data in the form of frequencies or nominal values (Brink, van der Walt and van Rensburg (2017:179).

Like the chi-squared test, the Fisher exact test assesses for independence between two variables when the comparing groups are independent and not correlated. However, the chi-squared test relies on an approximation while Fisher's exact test is one of exact test. Fisher's exact test assesses the null hypothesis of independence by applying hypergeometric distribution of the numbers in the cells of the table (Kim 2017:152-154). Non parametric Kruskal-Wallis tests allow for the comparison of the distributions between groups. Nonparametric tests are preferred when the assumptions of parametric tests cannot be achieved or the sample size is small (Dwivedi *et al.* 2017:2187)

This chapter described the process which the research study followed. The next chapter will present the results of the VARK questionnaire and the analysis of the relationship between the learning style preferences and demographics of chiropractic students and their academic results.

CHAPTER 4 RESULTS

4.1 INTRODUCTION

This chapter presents an analysis of the results gathered through the VARK and demographic questionnaires. The results will be presented in the same order of the determined aims:

1. The demographics of the chiropractic students registered for examinations in the year. The findings will demonstrate the distribution of the respondents by year of study, gender and age.
2. The learning style preferences of the students determined by the VARK questionnaire.
3. The correlation between the students' learning style preferences, demographical data and academic performance in first to fifth year for 2019 will be presented.

These findings will be exhibited in the form of tables, charts and paragraphs.

4.2 DETERMINE THE DEMOGRAPHICS OF THE CHIROPRACTIC STUDENTS IN TERMS OF YEAR OF STUDY, GENDER AND AGE.

4.2.1 Year of Study

The demographic questionnaire was completed by 101 of the 132 chiropractic students who were enrolled for the relevant subjects for the 2019 examination period, resulting in a 76.5% response rate. The population size was less than what was estimated at the start of the study, which resulted in a sample size less than what was calculated in chapter 3.

The largest group of respondents (*n*=30) who enrolled in this study were registered for their first-year examinations in 2019, and the least number of respondents (*n*=15) were registered for their third and fifth year of study. **Figure 4.1** presents the distribution of the total number of respondents enrolled in each year of study for the examination period of 2019.

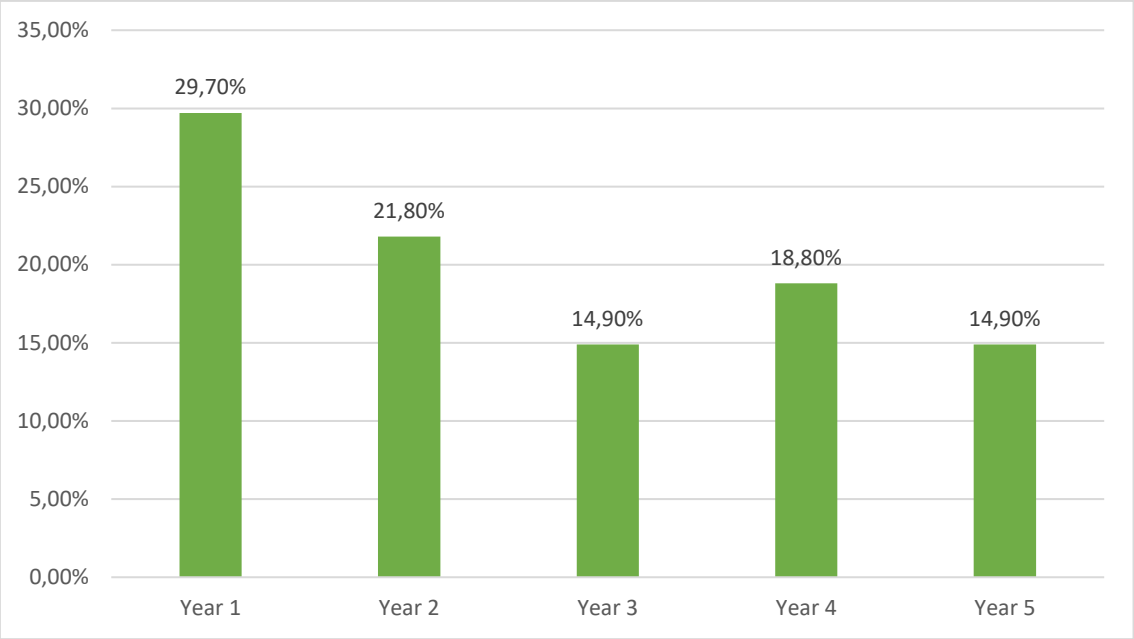

Figure 4.1: Distribution of respondents per year

4.2.2 Gender of the Students

Of the 101 students who participated in this study, *n*= 73 (72.3%) were female and *n*= 28 (27.7%) were male. **Figure 4.2** represents the gender distribution of the chiropractic students by year of study.

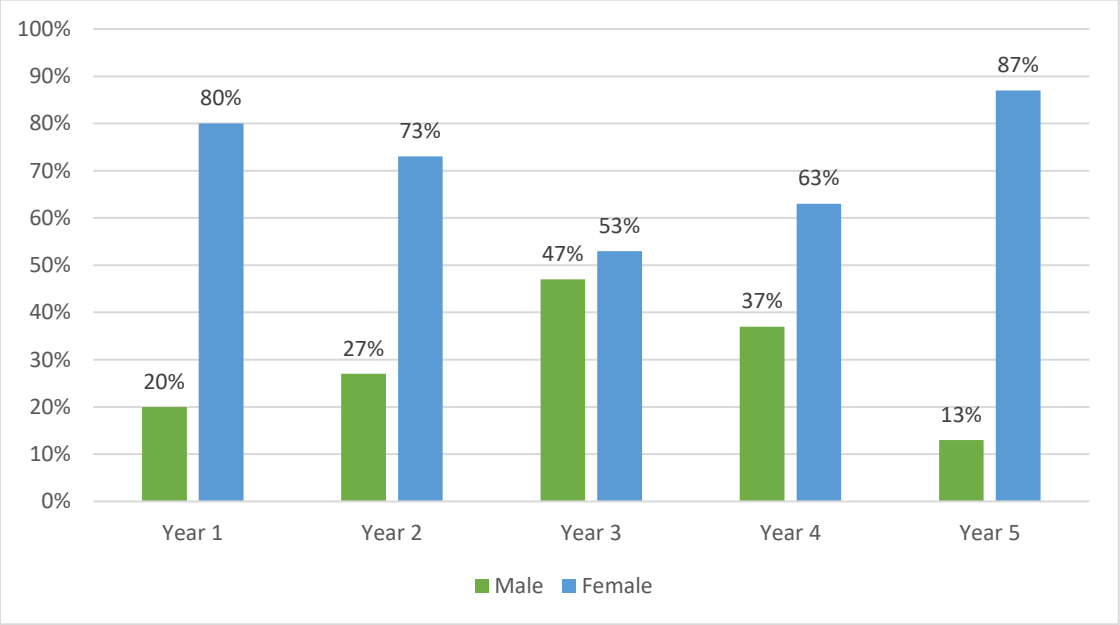

Figure 4.2: Gender of respondents

4.2.3 Age of the Students

With regards to age, of the total sample (*n*=101), *n*=80 (79.3%) of the students were 24 years of age or younger (Generation Z) and *n*=21 (20.7%) of the students were above 24 years of age (Generation Y). The mean age of the sample was reported as 28 years old, with a standard deviation of 3 years and a range from 19 to 33 years old. **Figure 4.3** indicates the age distribution of the respondents across each year of study.

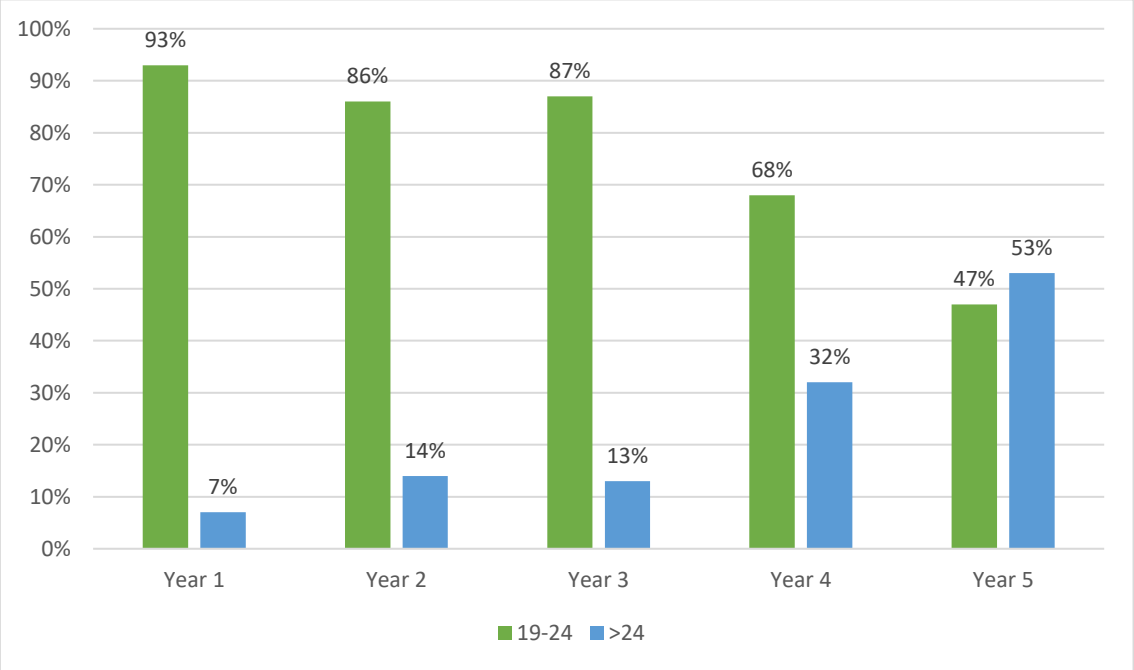

Figure 4.3: Age of respondents

4.3 TO DETERMINE THE LEARNING STYLE PREFERENCES OF THESE CHIROPRACTIC STUDENTS

The data collected from the VARK questionnaire suggest that, of the total respondents (*n*=101), the majority (*n*=62 ,61.4%) of the chiropractic students have unimodal learning style preferences, while the remainder of the students identified as multimodal (*n*=39, 38.6%). **Figure 4.4** illustrates the distribution of the chiropractic students across the multimodal and unimodal VARK modalities. Most of the respondents who recorded unimodal learning preferences were found

to be Kinaesthetic (*n*=37, 36.6%), followed by Aural (*n*=11, 10.9%), Visual (*n*=9, 8.9%), and Read/write (*n*=5, 5%).

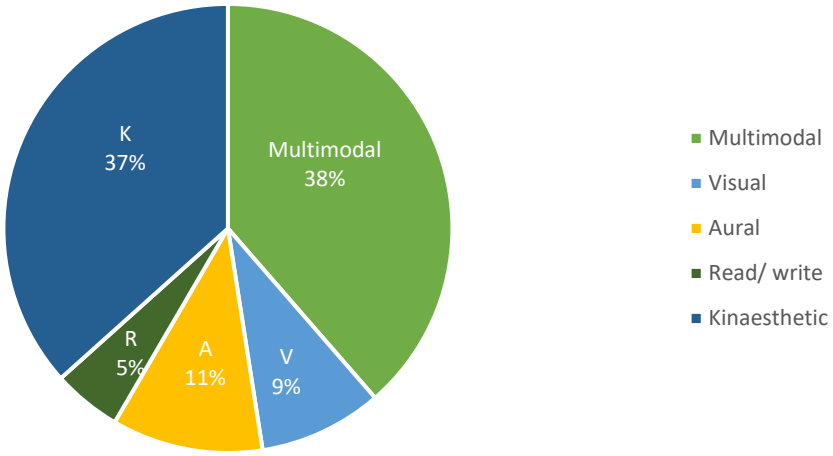

Figure 4.4: Frequency of VARK unimodal learning styles

Of the 39 students who recorded a multimodal learning preference, 64.1% (*n*=25) had a quadmodal preference, followed by 35.9% (*n*=14) with a bimodal preference. None of the students recorded a trimodal learning preference. In addition, only three of the possible six bimodal combinations available were recorded as preferred modes by the students in this study. The three combinations of bimodal preferences (from highest to lowest) were VK (*n*=8, 20.5%), AK (*n*=5, 12.8%), and VA (*n*=1, 2.6%). These combinations are presented in **Figure 4.5**.

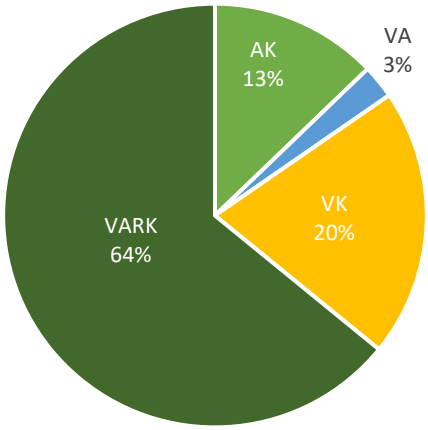

Figure 4.5: Frequency of specific combinations in multimodal learners

Mean VARK scores for individual sensory modalities of learning are shown in **Table 4.1**. The mean score was highest for kinaesthetic learning (8.66 ± 3.23) and lowest for read/write learning (4 ± 3.41).

Table 4.1: Mean scores of individual VARK components

VARK Component		Mean	Standard Error of Mean	Standard Deviation
Total	Visual	5.35	.32	3.19
	Aural	6.17	.32	3.22
	Read/write	4.00	.34	3.41
	Kinaesthetic	8.66	.32	3.23
	Total	**24.16**	**.94**	**9.49**

4.4 TO DETERMINE IF THERE IS A CORRELATION BETWEEN LEARNING STYLE PREFERENCES, DEMOGRAPHICAL DATA AND ACADEMIC PERFORMANCE IN FIRST TO FIFTH YEAR CHIROPRACTIC STUDENTS OF 2019.

4.4.1 Learning Style Preference and Year of Study

No significant relationships were found between the year of study and the students' unimodal and multimodal preferences. Of the 62 unimodal students, kinaesthetic learning was the most predominant preference across all years and in total of those who were unimodal. The distribution of learning style preferences by year of study is shown in **Figure 4.6**.

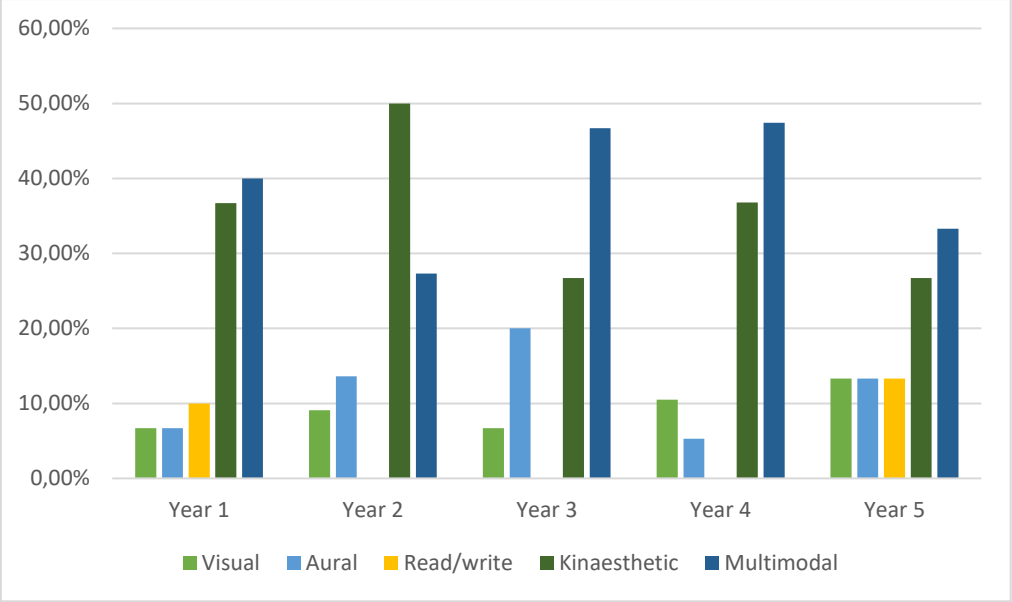

Figure 4.6: Distribution of learning style preferences by year

The mean scores of VARK components by year were not significantly different. These are shown in **Table 4.2**.

Table 4.2: Mean score of VARK components by year

			Mean	Standard Error of Mean	Standard Deviation
YEAR	1	Visual	5.40	.68	3.70
		Aural	5.77	.57	3.14
		Read/write	3.77	.63	3.43
		Kinaesthetic	9.07	.55	3.03
		Total	24.00	1.78	9.78
	2	Visual	5.36	.64	2.98
		Aural	5.73	.72	3.38
		Read/write	3.73	.59	2.75
		Kinaesthetic	9.68	.63	2.97
		Total	24.50	1.93	9.08
	3	Visual	6.93	.91	3.53
		Aural	8.13	.84	3.27
		Read/write	5.71	.62	2.30
		Kinaesthetic	9.47	.93	3.58
		Total	30.00	2.64	10.22
	4	Visual	3.89	.27	1.20
		Aural	5.58	.54	2.36
		Read/write	2.37	.65	2.81
		Kinaesthetic	7.21	.65	2.84
		Total	19.05	1.13	4.92
	5	Visual	5.47	.85	3.29
		Aural	6.40	.94	3.62
		Read/write	5.33	1.23	4.76
		Kinaesthetic	7.40	.88	3.42
		Total	24.60	2.76	10.70

No significant difference in preferred learning style was noted amongst multimodal learners based on year of study. This is demonstrated in **Table 4.3**.

Table 4.3: Specific learning style in multimodal learners

		Year		
		Median	**Percentile 25**	**Percentile 75**
Specific learning style in multimodal learners	AK	4	1	4
	VA	5	5	5
	VARK	3	1	4
	VK	3	1	5

The Independent-Sample Kruskal-Wallis test was applied to determine the correlation between:

1. The respondents' learning style preferences and year of study.
2. The respondents' year of study and preferred modality.
3. The participant's year of study and specific multimodality preference.

The results of these tests are displayed in **Table 4.4**.

Table 4.4: Independent-Samples Kruskal-Wallis Test for learning style, modality and specific multi-modality preferences

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of year is the same across categories of Learning style.	Independent-Samples Kruskal-Wallis Test	0.893	Retain the null hypothesis.
2	The distribution of year is the same across categories of modality.	Independent-Samples Kruskal-Wallis Test	0.854	Retain the null hypothesis.
3	The distribution of year is the same across categories of specific multimodal learning style.	Independent-Samples Kruskal-Wallis Test	0.474	Retain the null hypothesis.

With a significance level of 0.050, an asymptomatic significance is displayed in the described hypotheses.

No significant relationship was found between the learning style preferences and modalities of the respondents and their year of study. This is observed by the calculated *p*-values which were above 0.05 and therefore the null hypothesis was accepted. There was no significant difference between the learning styles and the year of study (p=0.893), nor between the modalities and the year of study (p=0.854). Amongst multimodal learners, there was no significant difference in year of study by specific learning style (p=0.474).

4.4.2 Learning Style Preference and Gender

No significant gender relationships were found in terms of unimodal and multimodal preferences. There was also no significant individual sensory modality preference observed among unimodal learners. A unimodal learning style preference was noted in 61.6% (n=45) of the females and 60.7% (n=17) of the males. While multimodal learning style preferences were documented for 38.4% (n=28) of the females and 39.3% (n=11) of the males.

Figure 4.7 depicts the distribution of unimodal (uni) and multimodal (multi) learning style preferences by gender and year of study.

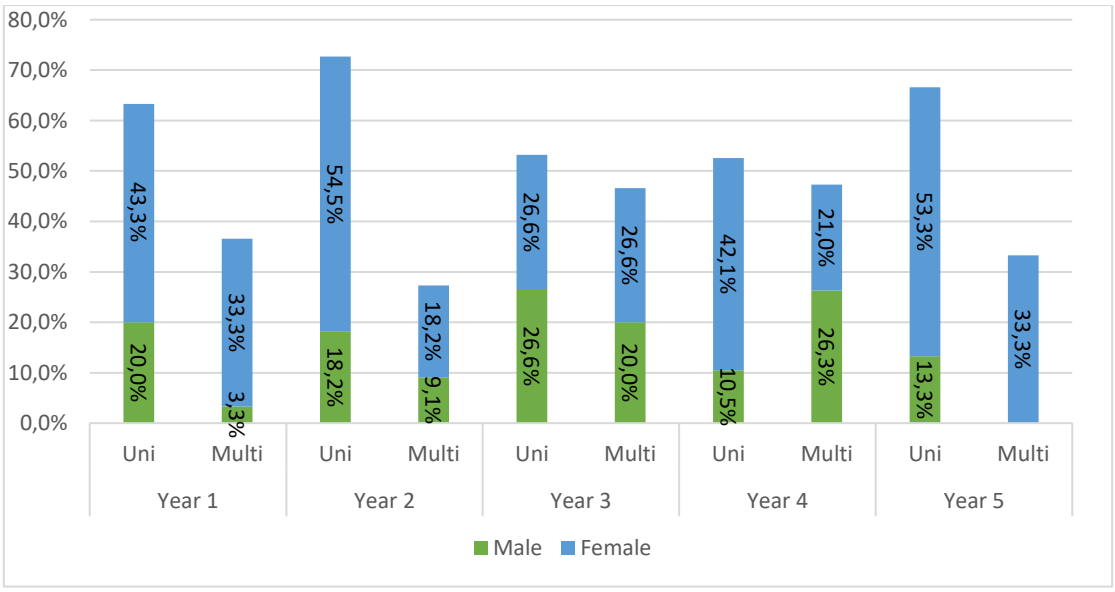

Figure 4.7: Distributions of learning style modalities by gender and year

Figure 4.8 and **Figure 4.9** below show the learning style preferences for males and females, respectively. Of the students who preferred one mode of information presentation, the males had a greater preference for Kinaesthetic learning (*n*=9, 32.1%), followed by Aural learning (*n*=6, 21.4%). The females showed a greater tendency towards Kinaesthetic learning (*n*=28, 38.4%), followed by Visual learning (*n*=7, 9.6%). The males had a low preference for Visual learning (*n*=2, 7.1%) and a non-existent preference for Read/write learning. The females had an equally low preference (*n*=5, 6.8%) for Aural and Read/write learning.

Of the six possible bimodal combinations (VA, VR, VK, AR, AK and RK), three combinations were recorded among the female students in this study. These were measured (from highest to lowest) as VK (*n*=7, 9.6%), AK (*n*=2, 2.7%) and VA (*n*=1, 1.37%). Only two of these preferences were found amongst the male students, viz. AK (*n*=3, 10.7%) and VK (*n*=1, 3.6%).

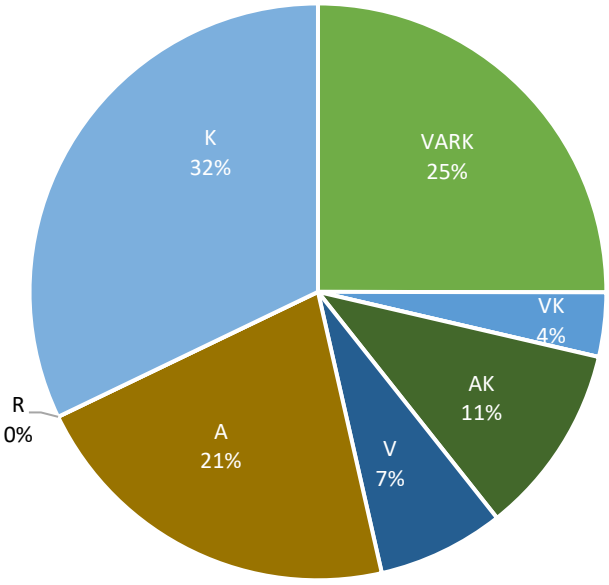

Figure 4.8: Learning style preferences of males

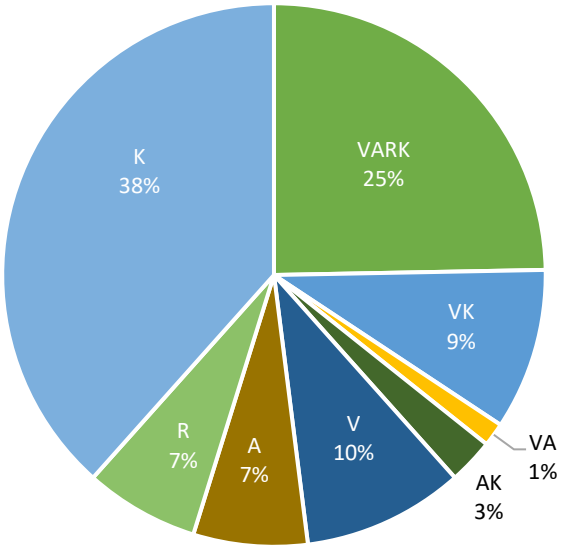

Figure 4.9: Learning style preferences of females

To determine if there were any correlations between the gender of the respondents and their learning style preferences, the Fisher-Freeman-Halton Exact test was used and awarded a value of 5.411. This is depicted in **Table 4.5** below. Pearson's chi-squared scores were calculated to determine the correlation of preferred modality by gender, and the correlation of specific multimodality preference by gender. The results of which are presented in **Table 4.6** and **Table 4.7** below.

Table 4.5: Fischer-Freeman-Halton Exact Test

	Value	Exact Sig. (2-sided)
Fisher-Freeman-Halton Exact Test	5.411	0.228
N of Valid Cases	101	

Table 4.6: Chi-squared test for modality preference

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.009[a]	2	0.996
N of Valid Cases	101		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 3.88.

Table 4.7: Chi-squared test for multimodality preference

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.864[a]	3	0.277
Likelihood Ratio	3.995	3	0.262
N of Valid Cases	39		

a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is 0.28.

It was noted that there were no significant relationships between the learning style preferences and modalities of the respondents and their gender. There was found to be no significant difference between the genders of the respondents and their learning style preferences (p=0.228). Also, the learning modalities were not significantly different between the genders (p=0.996). Amongst the multimodal learners, there was no significant specific preference for any bimodal or quadmodal combination by gender (p=0.277). Therefore, the null hypothesis was accepted.

4.4.3 Learning Style Preference and Age

The one-way ANOVA tests were applied, and it was determined that age was no different between the modalities (p=0.925), as presented in **Table 4.8**. There was also no difference in age between the learning styles (p=0.153), although there is a slight trend, as shown in **Table 4.9**, that read/write learning was the more popular preference amongst youngest and visual learning amongst the oldest respondents. For this reason, the null hypothesis was accepted.

Table 4.8: Distribution of learning modality by age

	n	Mean Age	Std. Deviation	Age		*p*-value
				Minimum	Maximum	
BI	14	22.64	2.977	19	29	0.925
QUAD	25	22.48	2.600	19	31	
UNI	62	22.74	2.863	19	33	
Total	101	22.66	2.790	19	33	

Table 4.9: Distribution of learning style preference by age

	n	Mean Age	Std. Deviation	Age		*p*-value
				Minimum	Maximum	
V	9	24.67	4.183	20	33	
A	11	23.18	1.888	21	27	
R	5	21.40	2.881	19	25	0.153
K	37	22.32	2.583	19	30	
Multi	39	22.54	2.703	19	31	
Total	101	22.66	2.790	19	33	

Amongst multimodal learners, there was no significant difference noted between the age of the student and their learning style preferences (p=0.250). This is depicted in **Table 4.10**.

Table 4.10: Distribution of multimodal learning style preferences by age

	n	Mean Age	Std. Deviation	Age		*p*-value
				Minimum	Maximum	
AK	5	23.40	3.507	20	29	0.250
VA	1	27.00	.	27	27	
VARK	25	22.48	2.600	19	31	
VK	8	21.63	2.264	19	25	
Total	39	22.54	2.703	19	31	

4.4.4 Relationship Between Learning Style Preference and Academic Results for Practical and Theory Examinations

No significant difference was noted between the modality preferences nor learning style preferences in terms of theory or practical marks, as is shown by **Table 4.11** and **Table 4.12**, respectively.

Table 4.11: Significance of learning modality and academic result

		n	**Mean Academic Result**	**Std. Deviation**	**Academic Result**		***p*-value**
					Minimum	Maximum	
THEORY	BI	14	62.238	7.7069	50.5	76.0	0.150
	QUAD	25	58.573	15.1395	21.5	80.0	
	UNI	62	63.763	9.8296	41.5	90.5	
	Total	101	62.267	11.2458	21.5	90.5	
PRACTICAL	BI	14	66.048	6.2153	53.0	73.5	0.054
	QUAD	25	59.647	15.0868	26.5	86.5	
	UNI	62	66.056	10.4234	36.0	94.0	
	Total	101	64.469	11.5607	26.5	94.0	

Table 4.12: Significance of learning style preference and academic result

		n	Mean Academic Result	Std. Deviation	Academic Result		*p*-value
					Minimum	Maximum	
THEORY	V	9	59.000	9.9404	41.5	76.0	0.161
	A	11	68.621	10.3905	54.0	86.0	
	R	5	63.800	7.1990	55.0	74.0	
	K	37	63.473	9.6459	49.5	90.5	
	Multi	39	59.889	12.9712	21.5	80.0	
	Total	101	62.267	11.2458	21.5	90.5	
PRACTICAL	V	9	61.963	10.7186	39.5	78.5	0.083
	A	11	72.015	9.6955	61.7	93.5	
	R	5	60.733	7.4205	48.5	66.7	
	K	37	66.000	10.3614	36.0	94.0	
	Multi	39	61.944	12.9092	26.5	86.5	
	Total	101	64.469	11.5607	26.5	94.0	

The means of the marks were quite similar across the learning styles, with a large overlap of confidence intervals between the groups, as shown in the error bar plots below. In the plot illustrating the relationship between preferred learning style modalities and academic performance for both theory and practical examinations (**Figure 4.10**), quadmodal learners were shown to have the lowest mean mark as well as the lowest reported mark.

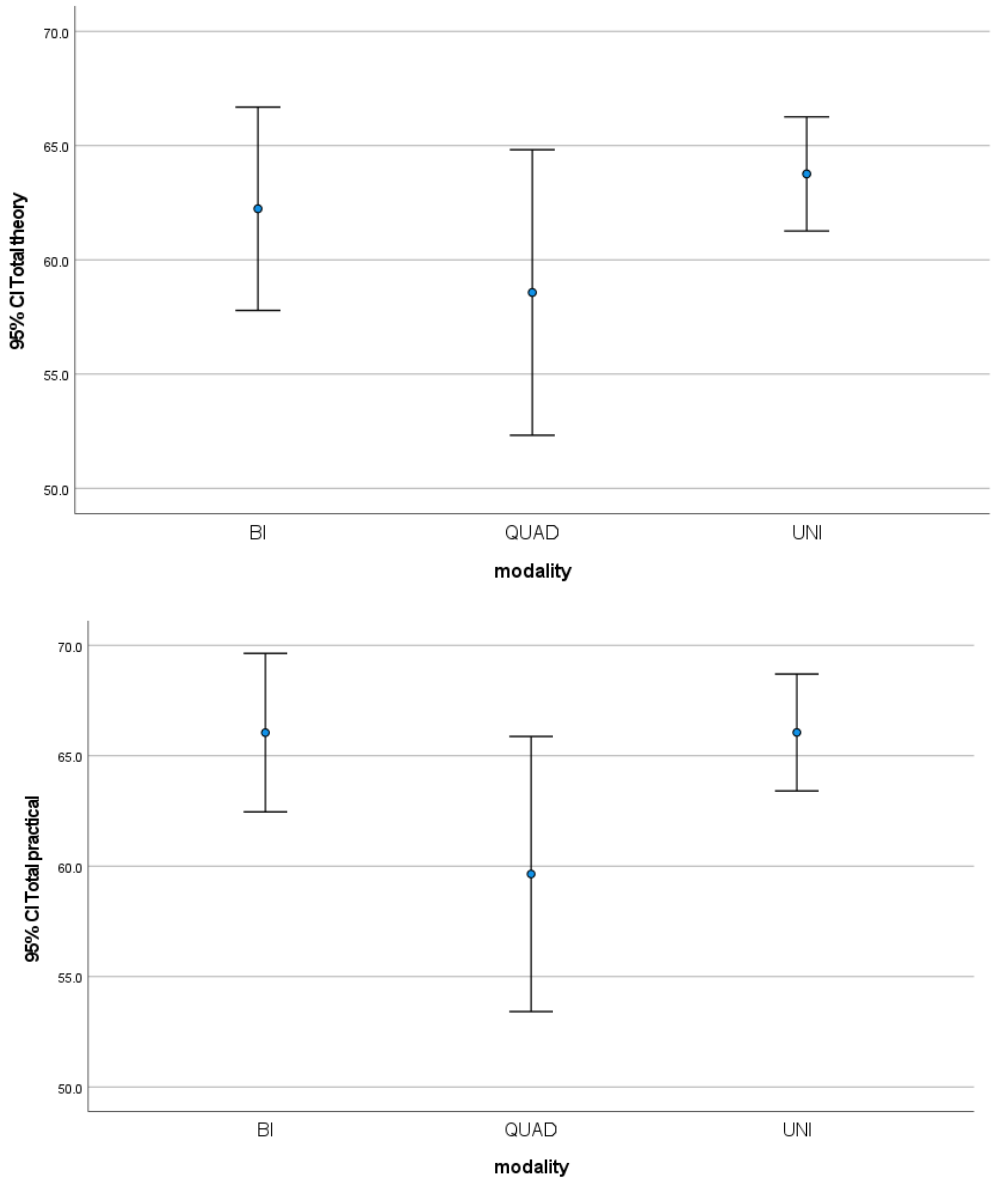

Figure 4.10: Error bar plots showing the relationship between preferred learning style modalities and academic performance for theory and practical examinations

The students with aural learning style preferences had the highest mean mark and minimum mark in both theory and practical examinations. There was a large overlap in confidence levels in the remaining preferences, with little difference in their means present. This is shown in the plot in **Figure 4.11**.

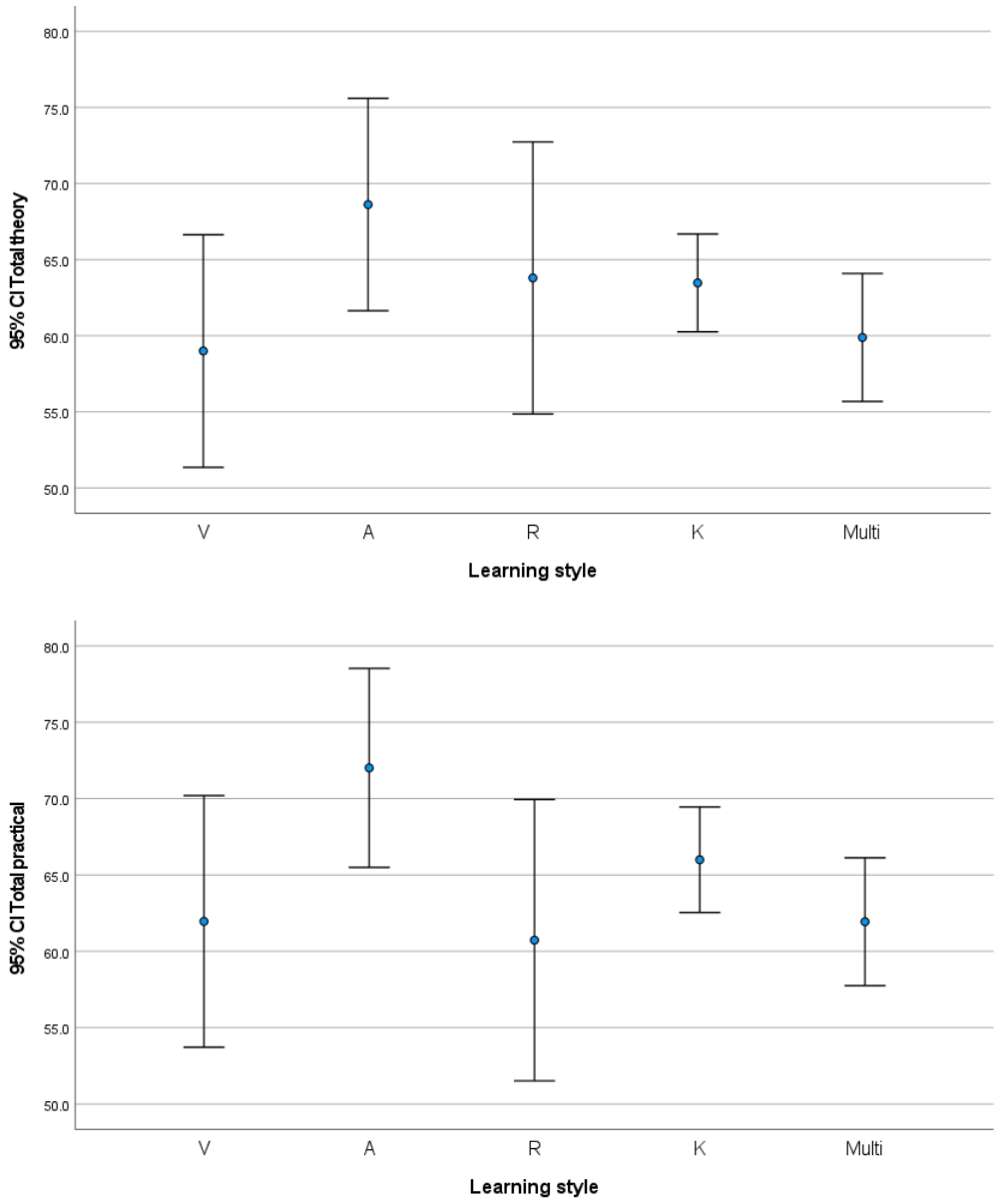

Figure 4.11: Error bar plots showing the relationship between learning style preferences and academic performance for theory and practical examinations

As the calculated values were less than the critical value of the performed one-way ANOVA value, the null hypothesis is accepted. This proves that there is no correlation between the learning style preferences of the chiropractic students and their academic performance.

4.5 CONCLUSION

In this chapter, the results obtained while conducting this study were presented and analysed using a variety of statistical tests. The analysis of learning style preferences confirmed that chiropractic students have a preference for kinaesthetic unimodal learning. It was found that their year of study, gender and age have no statistically significant effect on learning style preferences. It was also determined that learning style preferences have no statically significant influence on academic success.

The following chapter will discuss these results further, as well as their implications.

CHAPTER 5 DISCUSSION

5.1 INTRODUCTION

This chapter begins with a discussion of the results presented in chapter 4. It is presented in order of the objectives to answer the research question “do the learning style preferences of the students influence their academic performance?”. To this end, the results of the VARK questionnaire will be discussed and any relationship to the students’ academic performances, as well as demographical information, will be explored. Lastly, the limitations of this study will be highlighted.

5.2 DISCUSSION OF DEMOGRAPHICS

The researcher’s first aim was to determine the demographics of the chiropractic students at DUT in terms of year of study, gender and age.

5.2.1 Year of Study

As expected, most of the respondents were enrolled in first year during the examination period of 2019. The researcher did not find this to be unusual, as students do fail examinations and change their field of study, which results in less students in the final years of study. This trend is typical of South African universities’ low participation and high attrition rates, as described by Cloete (2014:1358).

Moodley and Singh (2015:101) identified the reasons given by students who had withdrawn from tertiary education. The major themes they presented were affordability, lack of academic support, lack of career guidance, lack of self-discipline and commitment, and being a first generation student. Many of those interviewed found that the classes were too large and the content was too difficult (Moodley and Singh 2015:103).

Students finding difficulty with the curriculum could be a result of poor secondary education, leading to an “articulation gap” (Tewari and Ilesanmi 2020:3). The

results of this study are consistent with those of Hess and Frantz (2014:46), in a study on physiotherapy students in South Africa, where 85 students were enrolled in first year compared to only 36 enrolled in the fourth year of study.

Innes (2017:4), at a chiropractic university in Australia, found similar results where students in first and second year were the majority and the least students were found in the fifth year. However, this is in contrast to the results of Whillier *et al.* (2014:22), at a chiropractic college in Australia, where little difference in the number of respondents enrolled in years one and five were seen.

5.2.2 Gender

It was found that the chiropractic programme was predominantly female and that only 28 of the 101 respondents were male. This may be due to the restructuring of the programme, in line with what has occurred at other medical schools, in terms of gender and race following the end of the apartheid era, in which females and people of colour had limited access to tertiary education (Khan *et al.* 2013:77). This finding is consistent with the findings of Hess and Frantz (2014:46), where 75% of respondents were female and 25% were male. This is also in line with the CHE's total headcount of tertiary education enrolment for 2016, where 567 199 female and 408 697 male students were enrolled at a tertiary education institution (Council on Higher Education 2018:6).

However, this finding differs with the results of Whillier *et al.* (2014: 22) and Khanal *et al.* (2019:350), where the majority of the respondents, i.e. 58.6% and 64.8% respectively, were male.

5.2.3 Age

The majority (79.3%) of the students enrolled in chiropractic were found to be between 19 and 24 years of age, while 20.7% of students were found to be above 24 years of age. The large number of respondents who were between 19 and 24 years of age suggests that majority of the students enrolled shortly after completing the National Senior Certificate. The 20.7% of students who were over 24 years of age may have decided to study in another field before enrolling in chiropractic, or they could have chosen to work first and then study. This is in line

with the Council on Higher Education's (2018:7) report of headcount enrolments by age group, where those 20 to 24 years of age made up the greater cohort from 2011 to 2016.

Sommerville and Singaram (2018:281), in a study on medical students at a university in South Africa, found similar results where the age of the students at the start of their degree ranged from 17 to 33 years of age, with a median of 19.4 years and a modal value of 18 years. This is consistent with Whilier *et al.* (2014: 22), who categorized respondents as under or over 25 years of age and found 72.5% of respondents to be under 25 years and 27.5% to be over 25 years.

5.3 DISCUSSION OF LEARNING STYLE PREFERENCES

5.3.1 Unimodal and Multimodal Leaners

The second aim of this study was to determine the learning style preferences of these chiropractic students with the VARK questionnaire. The teaching styles of the programme's lecturers were classified as multimodal and kinaesthetic. In this research study, most students were found to prefer learning through one source of information presentation (61.4%).

The results achieved in this study contradicted the results on the VARK website from 2020 (VARK 2020), and some of those obtained by other studies in health sciences utilising the VARK questionnaire (Ally 2010:1-96, Khanal *et al*. 2019:234-355). The distribution of chiropractic students who favoured a unimodal preference (61.4%) and multimodal preference (38.6%), was in contrast to the results obtained on the VARK website (2020) and by Ally (2010:42) in a study on South African first year anatomy students. Both the VARK website and Ally (2010:42) found that 64% of respondents were multimodal and 36% were unimodal. The results also divert from the results of Khanal *et al.* (2019:346-347), where medical students showed a greater preference for multimodal learning.

Studies on medical students by Almigbal (2015:352) and Soundariya *et al.* (2017:1022) produced similar results, where 53.8% of respondents preferred one mode of information presentation and 46.2% preferred multiple modes. Hlousek

and Krause (2019:1), in their study on anatomy students, also found that unimodal learning was more popular (62.2%).

However, unlike this study, where kinaesthetic learning preference was found to be the most popular unimodal preference, Almigbal (2015:352) and Soundariya (2017:1022) found that of the unimodal visual learning preferences was the more popular choice.

Figure 5.1 below displays the results of this study along those found by the VARK website (2020), Ally (2010:1-96), Khanal *et al.* (2019:234-355), Almigbal (2015:349-355), Soundariya *et al.* (2017:1020-1025) and Hlousek and Krause (2019:1).

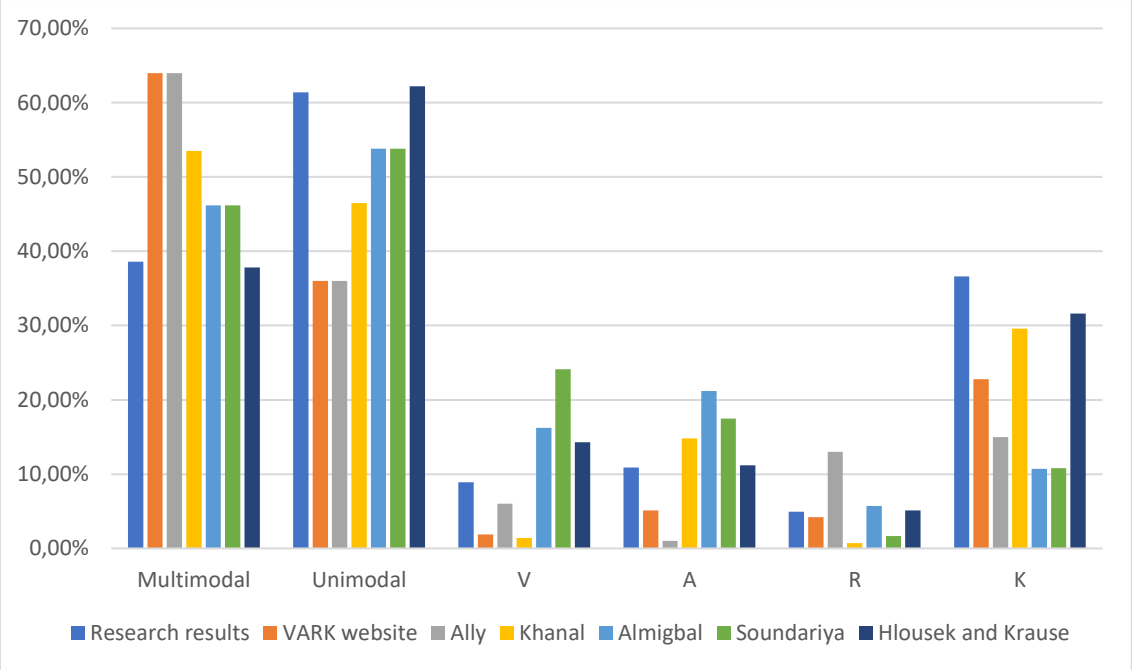

Figure 5.1: Comparison of results with VARK website and similar studies

5.3.2 Unimodal Learning Style Preferences

The unimodal preference most favoured by the respondents was kinaesthetic learning (36.63%) and it is consistent with the current teaching styles in the programme. This result compares favourably with other studies in health sciences, as well as those on the VARK website. Kinaesthetic learning was found to be preferred by 22.8% of respondents on the VARK website (2020), 15% by

Ally (2010:42), 29.6% by Khanal *et al.* (2019:346-347), and 31.6% by Hlousek and Krause's (2019:1). The least preferred preference of the chiropractic students in this study was read/write learning (5%). This compared favourably with other studies, where read/write learning was found to be preferred by 0.7% of respondents by Khanal *et al.* (2019: 346-347); 5.7% by Almigbal (2015:352); 1.67% by Soundariya *et al*. (2017: 1022); and 5.1% by Hlousek and Krause (2019:1).

Possible theories exist as to why kinaesthetic learning is the more popular preference amongst chiropractic students. Such theories include that chiropractic is a physical, hands on profession which would attract kinaesthetic-minded individuals (Whillier *et al*. 2014:25). An alternate explanation could be that learning is a process which integrates all senses. The kinaesthetic learning modality fits this definition well, where kinaesthetic learning has been defined as learning through all available senses. It is for this reason that some view the learning style concept as a false arguments about the brain, better known as a neuromyth (Horvath *et al*. 2018: 1-2).

5.3.3 Multimodal Learning Style Preferences

Of the 38.6% of respondents who identified as multimodal, 64.1% of them were found to be quadmodal and only 35.9%% of respondents preferred learning while making use of 2 modalities. Of the possible six bimodal preferences, only three were present in this study, viz. AK (12.8%), VA (2.6%) and VK (20.5%). None of the respondents were found to be trimodal. This is not an uncommon finding when using the VARK research algorithm, because of how the algorithm works. For a modality to be included in the preferences, the participant must have a proportionally higher score for that modality than most people (Fleming 2009:1). This approach involves a more statistical rationale when analysing the results compared to other studies where the standard method of result analyses were utilized (Fleming 2020, Ally 2010:1-96, and Khanal *et al.* 2019:234-355). Almigbal (2015:351) also found none of the respondents to be trimodal but a large cohort were quadmodal (43.5%) and a small cohort were bimodal (2.7%).

5.4 THE CORRELATION BETWEEN LEARNING STYLES AND ACADEMIC PERFORMANCE

The third aim of this study was to determine the relationship of academic performance in the first to fifth year chiropractic students of 2019 to their learning style preferences. Firstly, the influences of year of study, gender and age on learning style preferences will be explored.

5.4.1 Year of Study and Learning Styles

No significant findings were observed when comparing the distribution of learning style preferences by year of study. All of the years of study recorded a higher preference for learning while using only one modality, i.e. unimodal, with kinaesthetic unimodal learning being the most popular preference amongst all years. In their second, third and fourth years, none of the students were found to prefer read/write learning. This is consistent with both Whillier *et al.* (2014:24) and Salihu *et al.* (2020:48), in a study on medical students in Nigeria, where no significant difference in VARK category scores existed across the years of study.

5.4.2 Gender and Learning Styles

An analysis of gender differences in this study revealed no significant difference in the manner in which males and females preferred to learn and be taught. This compared favourably with Soundariya *et al.* (2017:1022) but was not consistent with the results of by Almigbal (2015:352), Khanal *et al.* (2019:349) and Ally (2010:59), who demonstrated significant differences between learning style preferences and gender.

The majority of the females (61.6%) and 60.7% of males in this study preferred one sensory mode, while the remaining females (38.4%) and males (39.3%) preferred learning through multiple sensory modes. This is consistent with the findings of Almigbal (2015:352), who found 50.8% of females and 56.9% of males were unimodal learners, but differs to that of Ally (2010:59), who found that 32% of females and 42% of males were unimodal learners.

The females of this study displayed a greater tendency towards kinaesthetic learning (38.4%) and a low preference of 6.8% for both the aural and read/write

learning. This is inconsistent with the results of Soundariya *et al*. (2017:1022), who found that females had a stronger preference for visual learning, as well as Ally (2010:46) who found that females had a greater preference for read/write learning.

The males in this study displayed a greater preference for kinaesthetic learning (32.1%) and a non-existent preference for read/write learning. This is consistent with Soundariya *et al*. (2017:1022), where male respondents had a strong preference for kinaesthetic learning and a weak preference for read/write learning. The results of Khanal *et al.* (2019:349) and Ally (2010:46) are also consistent with these findings, as kinaesthetic scores were higher among male respondents. Almigbal (2015:352), however, found that while aural learning was preferred by both male and female students, males had the stronger aural preference.

Gender differences in learning is a highly debated topic amongst all health care professions. There are a number of conflicting suggestions why learning styles may differ between male and female students but Nebeker *et al.* (2017:285) suggested, while examining surgical education, that females tend to prefer understanding the context and relevance of what is being asked, whereas males prefer skill acquisition and tend to be more internally motivated. Further research should be done to understand this phenomenon.

5.4.3 Age and Learning Styles

A slight trend seemed to emerge where read/write learning was the more popular preference amongst the youngest respondents and visual learning amongst the oldest students. It is not unusual to find little differences between the age groups as Generation Y and Z share some characteristics such as being culturally diverse, self-directed and technologically advanced.

The results of this study compare favourably with Alkooheji and Al-Hattami (2018:50), who found that the older age group had a preference for visual learning. However, studies by Ngala (2017:105), and Khanal *et al.* (2019:353) concluded that there were marginal differences in learning style preferences and therefore warned against categorizing learners based on their age variable.

The findings of this study were not consistent with the results of Whillier *et al*. (2014:24), who reported that no significant differences in learning style preferences existed between those below and above 25 years of age.

5.4.4 Academic Performance

The effect of learning style preferences on academic performance has been well explored in different parts of the world, but the results have not been consistent (Almigbal 2015:349-355; Schutz *et al.* 2011:8-9; Khanal *et al*. 2019: 234-355; Ally 2010:41-53).

Schutz *et al*. (2011:8-9) determined, using LASSI, that there were significant learning differences between the higher and lower performing chiropractic students of England. However, it should be cautioned that a study performed on a particular group cannot be generalised to other populations (Whillier *et al*. 2014:26). During this investigation, the researcher compared the distribution of VARK learning style preferences by the examination results, incorporating the theory and practical marks separately. It was observed that those who were lower achieving in both the theory and practical exam were more likely to be quadmodal learners, while those who were higher achieving in both theory and practical exams had a stronger preference for aural learning. However, these differences were not significant.

Similar results were found by Almigbal (2015:354) and Khanal *et al.* (2019:351), in which no significant differences in learning modalities were found. Khanal *et al*. (2019:351) did find a trend where more students who were higher achieving in theory examinations were unimodal, whereas in practical examinations both high and low achievers were more likely multimodal learners.

The outcome of this study indicated that not only do the majority of chiropractic students have a kinaesthetic learning style preference, but this preference is consistent in all of the years of study. Kinaesthetic learning appears to be a strong preference in other health science studies but in none of them does it present so strongly (VARK website 2020; Ally 2010:42; Khanal *et al.* 2019:346-347; Hlousek and Krause 2019:1).

Whilier *et al*. (2014:24) suggested that this could be due to chiropractic being a very hands on profession, which would attract kinaesthetic learners who would remain motivated throughout their years of study. The relationship between learning style preferences and academic performance suggests that identifying a single stronger preference may be more beneficial to the students than attempting to learn by multiple modes. Therefore, curriculum changes designed to encourage strategic learning might improve the academic performance of the students.

Although the research around learning style preferences may be conflicting, one would be remiss to neglect these findings. Teaching environments often promote the passive process of the lecturer providing information to the class, thereby forcing aural, visual and read/write learning, all of which have been shown to be least favoured by the chiropractic students. The kinaesthetic learners are more suited to practical lessons and tutorials where they are given the opportunity to participate and be active learners.

Research studies have shown to advocate catering for students' learning style preferences (Wilson 2011:41; Ally 2010:22; Khanal *et al.* 2019:353; Soundariya *et al.* 2017:1024; Schutz *et al.* 2011:8). The VARK profile reported in this study provide a good index to guide the strategies to adopt when teaching chiropractic students.

5.5 LIMITATIONS

The main limitation encountered in this study were the effects of the Covid-19 pandemic. The data collection was postponed due to the lectures taking place online to prevent transmission of the virus. As a result, adaptions were made to the questionnaire so that it could be completed online. Once lectures resumed on campus, those respondents who were not able to complete the questionnaire online were given the opportunity to do so then. This created a larger gap than what the researcher hoped for between the time which the respondents wrote the exam and completed the questionnaires.

Another limitation encountered was the use of the VARK research algorithm in determining the learning style preferences of the chiropractic students. Although more suitable for research, this is a more recently available approach with limited use in studies, thereby limiting the resources available for comparison with this study's results.

CHAPTER 6 CONCLUSION

6.1 CONCLUSION

From the VARK questionnaire, it can be concluded that, although the learning styles of the chiropractic students are diverse, unimodal learning was more commonly selected. The kinaesthetic mode was the most preferred among the unimodal learners, and the VARK combination was most selected among the multimodal preferences. The read/write learning scores were found to be more correlated with younger respondents, whereas visual learning scores were found to be correlated with older respondents.

Trends were found when examining the relationship of learning style preferences with gender and academic performance but these findings were not statistically significant. Despite no specific learning style predicting a better examination outcome, a knowledge of one's learning styles could empower students to utilize these techniques that are best suited to them so that their education may be enhanced.

If the chiropractic academic performance were to be improved, it would have a positive outcome on the graduation rates of the programme. As discussed in the literature review, many students are entering tertiary education underprepared and therefore are dropping out or performing poorly. Learning workshops should be held to help first year students identify their learning preferences. This is especially important for those *"at risk*", to help them realise that they are in fact "*different; not dumb*". Fleming (1995:1) recognised that there is no best way to teach but those who cater for the different needs of the students show better results. Therefore, the use of "hands on", or kinaesthetic learning, should continue to feature in chiropractic education, where students are encouraged to apply their knowledge or, simply put, "*learn by doing".*

Understanding the relationship between learning styles and academic performance could help in the identification of barriers to learning and the creation of interventions to improve learning experiences (Schutz *et al*. 2011:5). The

purpose of this study was not to label students but rather to provide information that will serve to improve communication between lecturers and students and enhance classroom and fieldwork education. It is hoped that through this knowledge, the students' experience of higher education and their overall success may improve, thus helping to decrease the high attrition rates and improve the low graduation rates currently plaguing South African higher education institutions.

6.2 RECOMMENDATIONS FOR FUTURE RESEARCH STUDIES

The researcher determined that examining the effect of race on learning style preferences and academic results would be of little value. This is because of the narrowed enrolment gap in tertiary education by race discussed in the literature review, as well as the emergence of classism. Bell and McKay (2011: 28) discussed the social, cultural and economic space in South Africa being divided amongst class and not racial lines. This would reflect in education, as political and economic changes are great influences. Bell and McKay (2011: 39) demonstrated the effects of socio-economic status on access to public secondary schools in Sandton, a former white area in Johannesburg. They determined that the schools had desegregated but the class profile had remained the same. There was no identified formal income discrimination but the role of school fees and travel costs, more so than catchment areas, have possibly led to the exclusion of poor and working class learners from schools where greater resources are available (Bell and McKay 2011:39, Pienaar and McKay 2014:118). It is for this reason that future research studies should investigate the effect of socioeconomic status on learning style preferences and academic performance.

Future investigations should be conducted utilizing a longitudinal design, as learning style preferences are not fixed and likely to change as students mature and progress through their academic career (Khanal *et al.* 2019:354). This study employed a cross-sectional study design, which is not ideal when determining the relationship between variables. A larger study is needed to include those students

of other institutions, as the sample from a single institution may not represent the population of chiropractic students in South Africa.

Future studies should examine the learning style preferences of the chiropractic lecturers and clinicians, and compare these with the preferences of the students, as studies have shown that each student typically adapts their learning preferences to their learning environment (Almigbal 2015:349).

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APPENDICES

Appendix A: Request for Permission to Conduct Research: Director - Research and Postgraduate Support

Dear Dr L. Linganiso

My name is Kate Dinkelmann, a Masters of Technology: Chiropractic student at the Durban University of Technology. The research I wish to conduct for my Masters dissertation involves the Learning style preferences of Chiropractic students at a university of technology and their effect on academic performance. My supervisor for the study is Dr Ally (PhD: Anatomy, MEd:Higher Education) and my co-supervisor is Dr Prince (MTech: Chiropractic).

I am hereby seeking your consent to conduct this study in the lecture venues at the Durban University of Technology at the end of the students' class time, as well as your permission to utilize the necessary examination marks of the students. The study aims to determine the learning style preferences of Chiropractic students at the Durban University of Technology and compare this to the demographics of the students as well as their academic performance.

The objectives of this study are to:

1. To determine the learning style preferences of Chiropractic students in year two to six.
2. To determine the demographics of these students in terms of age, gender, year of study and history of previous studies.
3. To determine if there is a correlation between learning style preferences and academic performance in second to sixth year Chiropractic students.

It is believed that understanding the relationship between learning styles and the various facets of the educational process could help overcome obstacles and enhance the students' learning experiences.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact us:

Role	***Name***	***Email***	***Phone number***
Researcher	Kate Dinkelmann	katedinkelmann@hotmail.com	081 097 2930
Main Supervisor	Dr F. Ally	fazilaa@dut.ac.za	031 373 2389
Co-supervisor	Dr C. Prince	cleop@dut.ac.za	031 373 2094

Thank you for your time and consideration in this matter.

Yours sincerely,

Kate Dinkelmann
Durban University of Technology

Appendix B: Request for Permission to Conduct Research: Heads of Department

Dear _____

My name is Kate Dinkelmann, a Masters of Technology: Chiropractic student at the Durban University of Technology. The research I wish to conduct for my Masters dissertation involves the Learning style preferences of Chiropractic students at a university of technology and their effect on academic performance. My supervisor for the study is Dr Ally (PhD: Anatomy, MEd:Higher Education) and my co-supervisor is Dr Prince (MTech:Chiropractic).

I am hereby seeking your consent to conduct this study in the lecture venues at the Durban University of Technology at the end of the students' class time, as well as your permission to utilize the necessary examination marks of the students (Chiropractic Principles and Practice, Diagnostics and Clinical Chiropractics). The study aims to determine the learning style preferences of Chiropractic students at the Durban University of Technology and compare this to the demographics of the students as well as their academic performance.

The objectives of this study are to:

1. To determine the learning style preferences of Chiropractic students in year two to six.
2. To determine the demographics of these students in terms of age, gender, year of study and history of previous studies.
3. To determine if there is a correlation between learning style preferences and academic performance in second to sixth year Chiropractic students.

It is believed that understanding the relationship between learning styles and the various facets of the educational process could help overcome obstacles and enhance the students' learning experiences.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact us:

Role	***Name***	***Email***	***Phone number***
Researcher	Kate Dinkelmann	katedinkelmann@hotmail.com	081 097 2930
Main Supervisor	Dr F. Ally	fazilaa@dut.ac.za	031 373 2389
Co-supervisor	Dr C. Prince	cleop@dut.ac.za	031 373 2094

Thank you for your time and consideration in this matter.

Yours sincerely,

Kate Dinkelmann
Durban University of Technology

Appendix C: Request for Use of Lecture Time

Letter of Information

Dear Respective Lecturer

My name is Kate Dinkelmann, a Masters of Technology: Chiropractic student at the Durban University of Technology. The research I wish to conduct for my Masters dissertation involves the Learning style preferences of Chiropractic students at a university of technology and their effect on academic performance. My supervisor for the study is Dr Ally (PhD: Anatomy, MEd:Higher Education) and my co-supervisor is Dr Prince (MTech:Chiropractic).

I am hereby seeking your consent to conduct this a survey in 15 minutes of your lecture time. The study aims to determine the learning style preferences of Chiropractic students at the Durban University of Technology and compare this to the demographics of the students as well as their academic performance.

The objectives of this study are to:

1. To determine the learning style preferences of Chiropractic students in year two to six.
2. To determine the demographics of these students in terms of age, gender, year of study and history of previous studies.
3. To determine if there is a correlation between learning style preferences and academic performance in second to sixth year Chiropractic students.

It is believed that understanding the relationship between learning styles and the various facets of the educational process could help overcome obstacles and enhance the students' learning experiences.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact us:

Role	***Name***	***Email***	***Phone number***
Researcher	Kate Dinkelmann	katedinkelmann@hotmail.com	081 097 2930
Main Supervisor	Dr F. Ally	fazilaa@dut.ac.za	031 373 2389
Co-supervisor	Dr C. Prince	cleop@dut.ac.za	031 373 2094

Thank you for your time and consideration in this matter.

Yours sincerely,

Kate Dinkelmann
Durban University of Technology

Appendix D: Permission to Use VARK Questionnaire

In an email communication on the 7th of August 2019 with a representative of VARK, Heather Lander:

Hi Kate,

Your request to use VARK copyright materials (specifically, paper copies of the VARK questionnaire) in your research is approved.

Approval is conditional on you finding out the VARK preference for each student and sharing that information with them. When you use paper copies of the questionnaire, you will be able to work out the total scores for Visual, Aural, Read-Write and Kinesthetic, but you will not be able to find out the resulting VARK preference. It is not appropriate to just choose the modality with the highest score, as a majority of people have a multimodal learning preference. Your options for finding out the VARK preferences are to either:

a) purchase a VARK result analysis from us (http://vark-learn.com/product/vark-result-analysis-for-researchers/). You will then be able to send us a spreadsheet containing the total scores for V, A, R and K for each student, and we will analyse their scores and return the spreadsheet to you with an additional column showing the VARK preferences. There is a cost of NZ$30 for this service.

b) direct the students to fill in the VARK questionnaire online at the http://vark-learn.com website. They will then automatically find out their VARK preference when they have completed the questionnaire. If you then need their results, you will need to ask them to report their preference back to you. There is no fee for using the online version of the VARK questionnaire.

c) purchase a VARK Subscription Site (http://vark-learn.com/product/vark-subscription/). Students will then be able to fill in the questionnaire online and find out their preference immediately, and their results will be automatically saved for you to access. The cost for this for 150 students would be NZ$195.

Please note that you may not place VARK copyright materials online or on another website, whether password protected or not, or on any electronic survey instrument (QUALTRICS, SURVEY MONKEY, MOODLE, YouTube, APPs, SMS, social media, LMS GOOGLE Forms, PDF...).

For legitimate use we ask that you provide this acknowledgement:

© Copyright Version 8.01 (2019) held by VARK Learn Limited, Christchurch, New Zealand.

Best wishes for your research project.
Regards,
Heather

Heather Lander
VARK LEARN Limited
7 Farnswood Place, Redwood, Christchurch 8052, New Zealand
www.vark-learn.com

Appendix E: Ethical Clearance for the Research Project

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

2 July 2020

Ms K L Dinkelman
14A Sunnyside Avenue
Hillcrest

Dear Ms Dinkelman

Learning style preferences of Chiropractic students at a University of Technology and their effect on academic performance
Ethical Clearance number IREC 029/20

The Institutional Research Ethics Committee acknowledges receipt of your notification regarding the piloting of your data collection tool.

In addition, the IREC acknowledges receipt of your gatekeeper permission letters.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Professor J K Adam
Chairperson: IREC

Appendix F: Institutional Clearance for the Research Project

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946

17th June 2020
Ms Kate Lynn Dinkelmann
c/o Department of Chiropractic
Faculty of Health Sciences
Durban University of Technology

Dear Ms Dinkelmann

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Full Permission** for you to conduct your research "Learning style preferences of chiropractic students at a University of Technology and their after effect on academic perfomance" at the Durban University of Technology.

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

We would be grateful if a summary of your key research findings can be submitted to the IRIC on completion of your studies.

Kindest regards.
Yours sincerely

_____
DR LINDA ZIKHONA LINGANISO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

Appendix G:Letter of Information

LETTER OF INFORMATION

Title of the Research Study: Learning style preferences of Chiropractic students at a university of technology and their effect on academic performance

Principal Investigator/s/researcher: Kate Dinkelmann (M.Tech Chiropractic)

Co-Investigator/s/supervisor/s:

Dr Fazila Ally, PhD (Anatomy) MEd (Higher Ed)

Dr Cleo Prince, M.Tech Chiropractic

Brief Introduction and Purpose of the Study:

This study aims to determine the learning style preferences of chiropractic students at the Durban University of Technology and compare this to student demographics and academic performance. It is believed that understanding the relationship between learning styles and academic performance could help identify barriers to learning and create interventions to improve learning experiences. The results of this study may be incorporated into lesson plans, thereby improving the delivery of information to chiropractic students.

Outline of the Procedures:

If you agree to participate in this study, you are requested to sign an informed consent form which allows information in the study to be utilized as well as access your academic results. Your name is not required, however we do ask for your student number. Once you have completed the questionnaire please place in the appropriate box. All information will remain confidential and will not be disclosed to any third parties. Please answer all of the questions as this will enable accurate statistical results.

Risks or Discomforts to the Participant:

There will be no risk to you if you participate in this study.

Benefits:

Your full co-operation will assist in expanding the knowledge of learning styles and thus enhancing classroom and fieldwork education in Chiropractic. We would like to publish the results of this study. On completion of the VARK (Visual, Aural, Read/write, Kinesthetic) questionnaire, you will have a score which will reveal your basic VARK result. You will have access to the VARK help sheets at the front of the class to assist with your learning techniques.

Reason/s why the Participant May Be Withdrawn from the Study

If you do not agree to sign the letter of information and informed consent form you will be withdrawn from the study. Participation of the study will be voluntary and no coercion will be used. Respondents will be free to decline or withdraw from the study at their request.

Remuneration:

No remuneration will be given.

Costs of the Study:

There will be no costs to you – the participant.

Confidentiality:

All completed questionnaires are to be kept in complete confidence. The questionnaire will be administered and collected by the researcher. The researcher will thereafter document the information for statistical analysis. All of the information is confidential and the overall results of the study will be made available in the Durban University of Technology library in the form of a dissertation. The results of this study will also be published in the form of a journal article in an accredited journal.

None of your individual responses will be made available to the university and at no time will your individual data/ responses be identifiable.

Research-related Injury: Not applicable

Persons to Contact in the Event of Any Problems or Queries: Please feel free to contact the:

- researcher Kate Dinkelmann (081 097 2930),
- supervisor Dr F. Ally (082 703 0006),
- co-supervisor Dr C. Prince (031 373 2094),
- Institutional Research Ethics Administrator (031 373 2375).

Complaints can be directed to the Deputy Vice Chancellor: Research, Innovation & Engagement, Professor Moyo (031 373 2576)

Appendix H: Letter of Informed Consent

Statement of Agreement to Participate in the Research Pilot Study:

- I hereby confirm that I have been informed by the researcher, Kate Dinkelmann, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: 029/20_____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, race, learning style preference and academic performance will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**	

I, Kate Dinkelmann (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Kate Dinkelmann **Full Name of Researcher**	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Appendix I: Questionnaire

Learning style preferences of chiropractic students at a university of technology and their effect on academic performance

SECTION A: DEMOGRAPHICS

Please complete this questionnaire by selecting the option that best applies to you using a X or filling in the required information

Student Number _____

SECTION A: Demographics

1. Age (years) _____

2. Gender

Male	Female	Other

3. Race

Black	Colored	Indian	White	Asian

If you selected OTHER, please specify what Race you are: _____

4. Current year of chiropractic program:

2nd year	3rd year	4th year	5th year	6th year

SECTION B: The VARK Questionnaire (Version 8.01)

Please choose the option which best suits you by circling the letter(s) next to it. You may circle more than one option or leave the question blank if you have not experienced the situation described.

1 I need to find the way to a shop that a friend has recommended. I would:

a. Find out where the shop is in relation to somewhere I know.
b. Ask my friend to tell me the directions.
c. Write down the street directions I need to remember.
d. Use a map.

2 A website has a video showing how to make a special graph or chart. There is a person speaking, some lists and words describing what to do and some diagrams. I would learn most from:

a. Seeing the diagrams.
b. Listening.
c. Reading the words.
d. Watching the actions.

3 I want to find out more about a tour I am going on. I would:

a. Look at details about the highlights and activities on the tour.
b. Use a map and see where the places are.
c. Read about the tour on the itinerary.
d. Talk with the person who planned the tour or others who are going on the tour.

4 When choosing a career or area of study, these are important for me:

a. Applying my knowledge in real situations.
b. Communicating with others through discussion.
c. Working with designs, maps or charts.
d. Using words well in written communication.

5 When I am learning I:

a. Like to talk things through.
b. See patterns in things.
c. Use examples and applications
d. Read books, articles and handouts.

6 I want to save money and decide between a range of options. I would:

a. Consider examples of each option using my financial information.
b. Read a print brochure that describes the options in detail.
c. Use graphs showing different options for different time periods.
d. Talk with an expert about the options.

7 I want to learn how to play a new board game or card game. I would:

a. Watch others play the game before joining in.
b. Listen to somebody explaining it and ask questions.
c. Use the diagrams that explain the various stages, moves and strategies in the game.
d. Read the instructions.

8 I have a problem with my heart. I would prefer that the doctor:

a. Gave me something to read to explain what was wrong.
b. Used a plastic model to show me what was wrong.
c. Described what was wrong.
d. Showed me a diagram of what was wrong.

9 I want to do something new on a computer. I would:

a. Read the written instructions that came with the program.
b. Talk with people who know about the program.
c. Start using it and learn by trial and error.
d. Follow the diagrams in a book.

10 When learning from the internet I like:

a. Videos showing how to do or make things.
b. Interesting design and visual features.
c. Interesting written descriptions, lists and explanations.
d. Audio channels where I can listen to podcasts or interviews.

11 I want to learn about a new project. I would ask for:

a. Diagrams to show the project stages with charts of benefits and costs.
b. A written report describing the main features of the project.
c. An opportunity to discuss the project.
d. Examples of where the project has been used successfully.

12 I want to learn how to take better photos. I would:

a. Ask questions and talk about the camera and its features.
b. Use the written instructions about what to do
c. Use diagrams showing the camera and what each part does.
d. Use examples of good and poor photos showing how to improve them.

13 I prefer a presenter or a teacher who uses:

a. Demonstrations, models or practical sessions.
b. Question and answer, talk, group discussion or guest speakers.
c. Handouts, books or readings.
d. Diagrams, charts, maps or graphs.

14 I have finished a competition or test and would like some feedback. I would like to have feedback:

a. Using examples from what I have done.
b. Using a written description of my results.
c. From somebody who talks it through with me.
d. Using graphs showing what I have achieved.

15 I want to find out about a house or an apartment. Before visiting it I would want:

a. To view a video of the property.
b. A discussion with the owner.
c. A printed description of the rooms and features.
d. A plan showing the rooms and a map of the area.

16 I want to assemble a wooden table that came with parts (kitset). I would learn best from:

a. Diagrams showing each stage of the assembly.
b. Advice from someone who has done it before.
c. Written instructions that came with the parts for the table.
d. Watching a video of a person assembling a similar table

visual * aural * read/write * kinesthetic

VARK®

a guide to learning styles

The VARK Questionnaire – Scoring Chart

Use the following scoring chart to find the VARK category that each of your answers corresponds to. Circle the letters that correspond to your answers.

e.g. If you answered b and c for question 3, circle V and R in the question 3 row:

Question	a category	b category	c category	d category
3	K	V	R	A

Scoring Chart

Question	a category	b category	c category	d category
1	K	A	R	V
2	V	A	R	K
3	K	V	R	A
4	K	A	V	R
5	A	V	K	R
6	K	R	V	A
7	K	A	V	R
8	R	K	A	V
9	R	A	K	V
10	K	V	R	A
11	V	R	A	K
12	A	R	V	K
13	K	A	R	V
14	K	R	A	V
15	K	A	R	V
16	V	A	R	K

Calculating Your Scores

Count the number of each of the VARK letters you have circled to get your score for each category:

Total number of **V**s circled =	
Total number of **A**s circled =	
Total number of **R**s circled =	
Total number of **K**s circled =	

Fill in the questionnaire online at http://vark-learn.com/the-vark-questionnaire/ to find out your VARK learning preference.

 http://vark-learn.com

Thank you for your participation in this study