LINKING LEARNING, TEACHING AND ASSESSMENT STYLES FOR ANATOMY STUDENTS AT A SOUTH AFRICAN UNIVERSITY OF TECHNOLOGY

By

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"Do not then train youths to learning by force and harshness, but direct them to it by what amuses their minds so that you may be better able to discover with accuracy the peculiar bent of the genius of each."

_____Plato

As the candidate's Supervisor I agree/do not agree to the submission of this dissertation.

_____   _____

Frances O'Brien   Date

DECLARATION

I, <u>Fazila Ally</u> declare that

The research reported in this dissertation, except where otherwise indicated, is my original work.

This dissertation has not been submitted for any degree or examination at any other university

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Abstract

South African higher education institutions are being increasingly plagued by high attrition rates (especially in first year) and low graduation rates. The students entering the higher education institutions have diversified considerably in terms of race, level of maturity and level of preparedness for the higher education system. This change in student characteristics has led higher education institutions to urgently investigate strategies to enhance the teaching and learning environment, so that these students can be empowered to transcend their backgrounds and achieve their potential. One such strategy identified by the Council of Higher Education is the matching of teaching styles to students' learning styles to improve the performance of the students and ultimately the retention rates of the institution.

This study aimed to explore the learning styles of the first year anatomy students at a South African University of Technology, to ascertain any association between gender and these learning styles and to investigate the impact of matching teaching and assessment styles to student learning styles. The VARK learning style questionnaire was used to determine the students' learning styles. The VARK learning styles are based on four sensory modalities that a student may use to receive, process and transmit information. Sixty seven students completed the VARK questionnaire, the majority of whom favoured a combination of learning styles. The most commonly exhibited unimodal (single) learning style was the kinaesthetic mode, while both genders recorded a multimodal learning preference. No significant relationship was found between the performance of students whose learning styles were matched to the teaching and assessment styles and those where the learning styles were mismatched with the teaching and learning styles.

This study served to highlight the diversity (in terms of learning styles) present among the first year anatomy students.

The study advocates a teaching and assessment strategy that is balanced and is considerate of multiple learning styles rather than attempting to match the teaching and assessment strategy to the learning styles of the students.

CHAPTER ONE

INTRODUCTION

The purpose of this study was to determine the learning style profiles of a group of first year Anatomy students at a South African University of Technology, to introduce different teaching and assessment methods and to explore the relationship between student learning styles, teaching and assessment methods and student success rates. This study grew out of the need for higher education academics to find creative ways of helping students, especially in first year, to deal with the curriculum and hence help in the improvement of the student success and retention rates.

In this chapter, I shall highlight the current status of Higher Education institutions, the problems they face and the attempts that have been made thus far to address the problems. I shall further describe the current status of the teaching, learning and assessment of the anatomy course and the remedial activity employed by my institution.

Rationale for the study

With the demise of the apartheid system in 1994, the need to begin equalizing opportunities for all race groups in South Africa and to wipe out past injustices, brought particular attention to bear on Higher Education institutions (Badat, 2002, p. 237, 2009; Boughey, 2007). The result of this focus, coupled with the rush to level the playing fields of all race groups (and more especially the disadvantaged Black population) led to a "surge in demand for participation in Higher Education" (Scott, 2009b, p. 18), and culminated in mass enrolment of

students into the higher education system. As a result, the characteristics of the first-year undergraduate classes in Higher Education institutions both nationally and internationally, shifted from being fairly homogenous, to a greater diversity in terms of abilities, cultures and level of maturity (Scott, Yeld, & Hendry, 2007).

According to a study by the Department of Education (DoE) (which tracked student performance and movement through the system), the Black and Coloured population enrolment had doubled over the last decade and currently stands at 70% (*Education Statistics in South Africa 2007*, 2009). This report is corroborated by a newspaper article in The Economist ("South Africa's education system: No one gets prizes," 2010), that reported that the number of Black enrolments into university had quadrupled over the past 15years. However merely improving access to Higher Education does not translate to equity in participation unless it is coupled with real opportunity for students to succeed in the system (Badat, 2002) and while equity of access is still far from acceptable, the focus of Higher Education institutions needs to be shifted to progress in equity of outcomes (Scott, et al., 2007).

The Council on Higher Education (CHE) monitored the performance patterns of undergraduates in South Africa, finding that all Higher Education institutions experienced high attrition rates (especially at first year level) and low graduation rates (15% for South Africa) of students (Scott, et al., 2007). On a more local level, this problem was also highlighted in a faculty of Health Sciences report in the University of Technology in which this study was conducted. One of the most alarming statistics to emerge from the CHE cohort analysis is that fewer than 5% of the Black students aged 20-24 years are actually achieving success in the system and graduating with a recognized qualification (Ian Scott, 2009b). Hence the net effect is that "progress in equity of access is effectively nullified by lack of progress in equity of outcomes" (Scott, 2009b, p. 22). Given the high levels skills shortages (Badat, 2002;

Hogg, 2009; Scott, 2009b; Subotzky, 2010), this performance pattern cannot be sustained in post apartheid South Africa. Hence the question that begs to be asked at this stage is who or what has contributed to the current situation in Higher Education and what can be done to alleviate the problem?

The poor performance of the schooling system in South Africa has been widely recognized as the main cause of students being not adequately prepared for the traditional forms of higher education (Bloch, 2008; Scott, 2009b; Subotzky, 2010). In fact Bloch (2008, unpaginated) reported that "60 to 80% of our schools are dysfunctional, achieving poor education outcomes". According to a newspaper article in The Economist, the blame for the poor performance of the schooling system has to be attributed to the introduction of outcomes based education in 1998 at a fledgling stage of South Africa's democracy when the many schools were not sufficiently resourced to implement the ideas espoused by outcomes based education ("South Africa's education system: No one gets prizes," 2010).

 Fixing the schooling system has been described by Bloch (2008) as a 30-year task and although the government has started taking steps to change or improve the system by reverting to the three R's system of education, Higher Education institutions cannot expect to see the results of these changes for many years to come ("South Africa's education system: No one gets prizes," 2010).

While Pityana, chairperson of the Higher Education of South Africa and the Vice Chancellor of UNISA is of the view that bridging the gap between schools and higher education institutions is "not the responsibility of the institutions" (Gower, 2008) and this view is shared by many academics, Scott (2009b, p.28) contends that the Higher Education institutions should share the responsibility and "at least accommodate the current intake". Scott (2009b, p. 24) further argues that Higher Education institutions need to "identify factors

affecting student performance that are within its control, and to act on these to the best of its ability".

Higher Education therefore finds itself at a fork in the road and it has become incumbent for those involved to make a choice. Do we accept the status quo and continue with the attitude that the problem is not with us or do we choose the path of action and make moves to improve the status of Higher Education institutions even in the face of chaos in the schooling system?

One of the ways to improve the situation, suggested by Pityana in (Gower, 2008) is the introduction of a four-year undergraduate degree. However de la Rey (in Gower, 2008) and Scott (2009b) points out that merely increasing the time spent in the undergraduate degree will not improve success rates of the students unless it is accompanied by concerted efforts to improve the quality of the process. In fact Pityana's suggestion could be viewed as the university academics still not wanting to take responsibility for their student intake.

Another suggestion is that improving student retention and graduation requires that "outcomes for Black students be raised to a minimum threshold that will equip them to function as workers and citizens in the new democratic era" (Letseka & Maile, 2008, p. 5). What does "raise to a minimum threshold" mean? If this is a call to lower standards, then this view is contested, by that which stresses that any strategies employed should not be at the expense of quality and excellence (Badat, 2002; Scott, et al., 2007). Badat (2002, p. 11) further points out that "if equity is not accompanied by quality, lip service is paid to equity and a distorted equity is promoted, which does not in any substantive and meaningful way erode the domination of high level occupations and intellectual production by particular social groups".

The first-year of undergraduate study has been identified by researchers as the key focus area for intervention methods (Scott, 2009b). This is linked to the

fact that the greatest student attrition has been attributed to the first year level and it is believed that helping students at this stage will have a snowballing effect for improved performance in subsequent years. This in turn will improve student retention and graduation rates.

Many Higher Education institutions have already introduced and have been running foundation or bridging courses to help academically disadvantaged students acclimate into the system by learning basic skills to help them cope with university life (Macgregor, 2007; Schreiner & Hulme, 2009; Scott, 2009a). The foundation programmes were introduced as early as the 1980's to facilitate the access and integration of Black students into the former white universities (Scott, 2009a). The problem with the foundation programmes and more specifically, the academic development part, is that very often the academic development officer responsible for teaching the students basic skills is not trained in the discipline in which he or she is serving and hence teaches generic skills which the students have difficulty in transferring into their disciplinary discourse. Consequently many students tend to ignore the very programmes that were meant to help them. Health Sciences, for example, has a very specific language that students tend to grapple with in first year but which they need to master in order to succeed in their senior years and working as health professionals. The academic development officer for the Health Science faculty should therefore be a person who has experience in the language of Health Sciences, especially that used in the basic courses.

Schreiner and Hulme (2009, p. 71) refer to the foundation programmes as "deficit remediation strategy" and state that although they were implemented with good intentions, by focusing on the inadequacies of the students, the students end up feeling demoralized, unmotivated and tend to decrease participation in the course. This view is supported by Scott et al (2007). The result of this is that students inadvertently avoid attending the very services that

are meant to help them thereby resulting in a vicious cycle of failure and attrition.

Scott et al (2007, p. 45) note that: "A key feature of successful approaches is that they are not 'remedial' but in various ways recognize and build on the capabilities that students bring with them into Higher Education, rather than being bound by traditional assumptions about what these capabilities should be." This strengths method focuses on, and builds students' innate abilities and strengths thus giving them a sense of self worth. Schreiner and Hulme (2009, p. 73) state "that the key to achieving at levels of personal excellence lies in teaching people to identify and capitalise on their greatest areas of talent." It is suggested therefore that academics in Higher Education institutions invest their time and energy in finding ways to recognize and cultivate the strengths of the current student intake. The building strengths method occurs in five stages (Schreiner and Hulme, 2009, p. 74):

i. Identifying the natural talent themes

ii. Affirming those themes with significant others

iii. Developing the talent themes by investing energy and effort in acquiring the necessary knowledge and skills to complement the existing talents

iv. Applying the developed strengths to new or challenging situations, and

v. Combining the strengths with other talents the students have, as well as with the talents of other people, to produce excellence.

It is believed that students that have a strong sense of self worth will be motivated, which in turn will improve the chances of student engagement in the learning process and overall persistence to graduation (Bitzer & Bruin, 2004; Fraser & Killen, 2003; Schreiner & Hulme, 2009).

Aims of the study

The challenge therefore facing academics of Higher Education institutions in South Africa is to move beyond the blame and to explore innovative ways to help and transform the incoming student body so that they can become high quality graduates and citizens of the country. One of the ways identified by Scott et al (2007) was to identify the learning styles of the student body and to cater for the diversity within the student body by designing courses in relation to student learning style preferences. This view was shared by Sims & Sims (1995, p. 10) who stated: "*With increased calls for accountability and assessment in higher education and calls for greater acceptance and appreciation of individual differences, higher education instructors cannot afford not to increase their understanding of learning and individual learning differences*". Scott et al (2007) stated that the efficacy of the higher education institutions lies in the ability of the sector to know its student body (Baykan & Nacar, 2007; Felder & Brent, 2005; Felder & Silverman, 1988; Sims & Sims, 1995; Slater, Lujan, & DiCarlo, 2007; Zeeb, 2004) and to create a learning environment that would empower students to succeed and thereby improve the pass rates and lower the high attrition rates. These imperatives formed a strong basis for the rationale of my study.

This study aimed to address the following questions:

1. What are the learning styles of the first year anatomy students?

2. Is gender associated with learning style?

3. Does matching student learning styles to teaching and assessment styles, affect student performance?

Two assumptions motivated this study:

By understanding the diversity of the learning preferences of the students in class, a more informed teaching and assessment method may be designed to cater for the differences in student population and therefore reach the majority of the students.

Making students aware of their learning preferences would empower them to take responsibility for their learning and improve their overall performance.

Description of research site
The South African University of Technology in which the study is based was born out of the merger between the traditionally White Natal Technikon and the traditionally Black ML Sultan Technikon. Following the merger, faculties were rearranged and distributed amongst the campuses of the now merged institution. The Faculty of Health Sciences formed a coalition of the health science courses of the two institutions. The Faculty of Health Sciences is home to a number of programmes such as Chiropractic, Homoeopathy, Dental Technology, Emergency Medical Care and Rescue, Radiography, Clinical Technology, to name a few. Also included in the Faculty of Health Sciences is a service department called the Department of basic Medical Sciences which caters for the teaching of the basic health science subjects such as Anatomy, Physiology, Pharmacology and Pathology. These subjects are usually taught in the first one or two years of the student's academic career. All the programmes offered by the Faculty of Health Sciences are vocationally based and the student is required to participate in work integrated learning as well.

The range of students accepted in the faculty, vary in terms of age, race and levels of preparedness for university life. The departments in the faculty do not have a standardized method in place to deal with the issue of underprepared

students or students who display potential. Some of the departments in the Faculty of Health Sciences at the University of Technology in which the research is situated have foundation courses while others used the extended curriculum model where the first year is split into two years. Students are chosen for this foundation phase or extended curriculum according to the results they obtain from a psychometric test that they write at the time of student selection interviews, their performance in the interviews, and the assessment of the assignments that have to be submitted as part of the application process. Those students that are admitted into the foundation phase, have their first year courses split into two years and attend academic development courses (which incorporate academic literacy, tutorial support and information literacy/ library skills) throughout the year.

The subject of Anatomy is taught to a wide range of students in the Faculty of Health Sciences. I will only highlight the teaching of Anatomy to the programmes that I am directly involved with. The Anatomy for the Chiropractic and Homoeopathy groups is spread over two years with half the body being taught in the first year and half in the second year. The Anatomy is taught using theory lectures coupled with a practical session that utilizes human cadaveric dissection, demonstrations, and teaching with skeletal specimens. The assessment of this course is done via three theory tests and two practical tests. The student generates a year mark for the year and is required to complete a summative assessment at the end of the academic year to ascertain if s/he will advance to the second year.

The Anatomy for the Radiography group is a continuous assessment course that consists of three modules. Module one is the introduction to Anatomy module (forms 10% of the total year mark) which incorporates the basic terms, definitions, relations and an introduction into the systems of the body. Module two is the musculoskeletal module (forms 60% of the year mark) which involves the study of all the bones in the body, how they develop, the joints

they participate in and the muscles that move these joints. Module three (forms 30% of the year mark) is the regional anatomy module which involves the study of the organs in the different regions of the body, their surface anatomy, their relations and their clinical significance. The student is assessed at the end of each module via theory tests and practical tests. Each module has a subminimum and any student who does not make the subminimum is allowed to rewrite the module once.

Overview of the dissertation

This chapter has provided an overview of the current status of students in the Higher Education institutions. Due to changes in the student demographics, it has been proposed that Higher Education shift from a passive information transfer environment to the creation of an environment for learning that is active and includes the students as part of the design (Buxeda & Moore, December 1999/ January 2000).

Chapter 2, the literature review deals with learning style definitions, the various types of learning styles, gender differences in learning styles, the benefits of using learning styles, the match versus mismatch debate, and highlights the learning style chosen for the research,

Chapter 3, the research methodology, depicts the methods that were employed in this study. The research plan is detailed, the teaching and assessment methods are described, and the data analysis procedures are indicated.

Chapter 4, the research findings, involves the presentation of the data collected and the analysis of the data. The data is displayed in the form of tables and graphs.

Chapter 5, the discussion and conclusion deals with the discussion of the research findings and conclusions drawn from the findings of the study, including recommendations for future research.

CHAPTER TWO

LITERATURE REVIEW

This chapter will present literature on the teaching and learning of Anatomy both locally and internationally. It will provide some insight on learning styles, the current debate regarding the use of matched and mismatched learning styles, the advantages of the use of learning styles, the influence of gender on learning styles and will also include an overview of research conducted on learning styles among health science students.

Teaching and learning Anatomy

The study of human anatomy forms a crucial part of medical and allied health education and is most often included in the first one or two years of the curriculum. Whilst its importance as a subject is recognized, a major debate rages on as to what is the best method of teaching and learning anatomy (Turney, 2007). Medical schools both locally and internationally teach anatomy using various methods such as the traditional method incorporating human cadaveric dissection and the use of supplemental prosected specimens (Kramer & Soley, 2002). New approaches such as problem-oriented methods (Boon, Meiring, Richards, & Jacobus, 2001), clinical case studies, small group teaching (Chan & Ganguly, 2008), and team-based learning (Nieder, Parmelee, Stolfi, & Hudes, 2005) have also been introduced.

Kramer and Soley (2002) surveyed a group of medical students in a South African University to elicit their views of the areas they perceived as

problematic in their anatomy curriculum. Suggestions derived from students in this survey, highlighted the need for more lectures, tutorials and more time spent on the topics. This is a common student complaint with regards to the study of anatomy but in light of decreased qualified staff and recent cutbacks (during re-curriculation) in time spent on the subject (Cahill, Leonard, & Marks, 2000; Kramer & Soley, 2002), the universities need to find new ways of helping students to succeed. While most energy in the teaching and learning of anatomy has been focused on the introduction of new teaching methods and their impact on student performance, minimal research has been conducted on how students learn anatomy and how the student learning styles affect student performance in the subject of human anatomy.

Learning style

Research spanning the last three decades has highlighted the issue that students learn differently and has stressed the need for the student to be viewed as an important component of the design of teaching and learning experiences. Most educators have accepted that students enter the learning environment with particular learning styles which may either aid or hinder their understanding, retention and subsequent manipulation or application of the subject matter at hand (McLoughlin, 1999). The definitions of learning styles are as varied and numerous as the models or inventories that have been developed through the decades to determine student learning styles.

For example, Grasha (1996, in Ramayah, Sivanandan, Nasrijal, Letchumanan, & Leong, 2009, p. 66) defines learning style as "personal qualities that influence a student's ability to acquire information, to interact with peers and the teacher, and otherwise to participate in learning experiences". Heywood (2000, p. 228) states, " A learning style, which may be the most important

characteristic of an individual in respect of learning, is the preferred way of the student to organize what they see and think about".

Many learning styles questionnaires exist; Dunn, Dunn and Price's Learning Style Inventory (1975-1999), Kolb's Learning Style Inventory (1984), Honey and Mumford's Learning Style Questionnaire (1992), Felder-Silverman's Learning Style Index (1988) and Fleming's VARK learning style inventory, each with its own distinct view of how students learn and each with its own questions of validity and reliability (Sharp, Bowker, & Byrne, 2008).

Learning Style Models

I have chosen to highlight three widely used and easily available (in online formats also) models of learning styles viz. the Kolb's Learning Style Inventory, Felder-Silverman's Learning Style Index and Fleming's VARK learning style preference.

Kolb's Learning Style Inventory

The Experiential Learning Theory developed by Kolb in 1984 describes learning as a cyclic activity in which knowledge is "created through the transformation of experience" (Hawk & Shah, 2007, p. 3). According to Kolb (1984), the learning process involves a cycle that incorporates concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE). The learning process may begin at any of the above stages depending on the learning preference of the student, but it would then continue through the cycle. Based on the student's position along the experiential learning cycle, Kolb initially identified 4 learning styles viz. converger, diverger, assimilator and accommodator. A diagrammatic representation, illustrating the combination of the four learning styles follows in the figure 1. below.
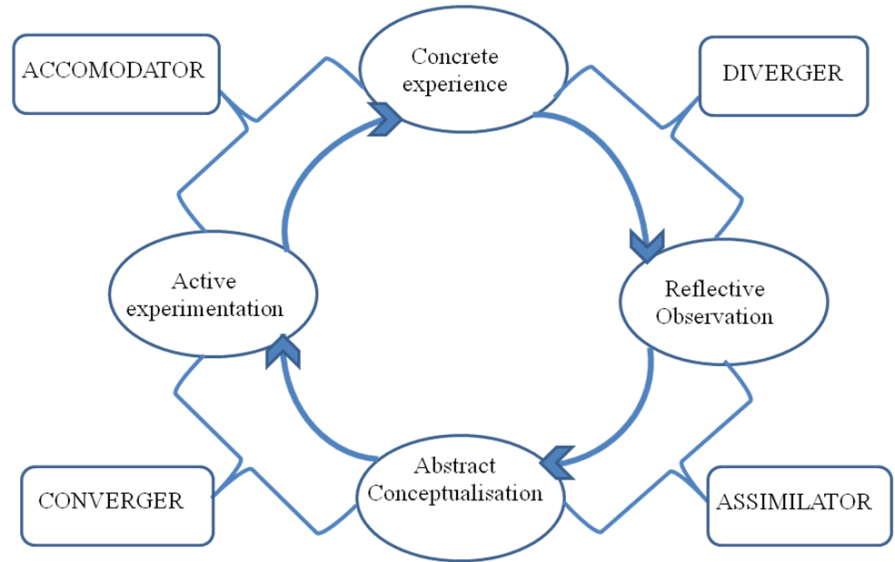
Figure 1. Kolb Experiential Learning Model (Based on Hawk and Shah, 2007)

Hawk and Shah (2007, p. 4) describe Kolb's learning styles as follows:

"Divergers (CE and RO) have a strong imaginative ability, are good at seeing things from different perspectives, are creative, and work well with people. Assimilators (RO and AC) have abilities to create theoretical models, prefer inductive reasoning, and would rather deal with abstract ideas. Convergers (AC and AE) have a strong practical orientation, are generally deductive in their thinking, and tend to be unemotional. Accommodators (AE and CE) like doing things, are risk takers, are in the here and now, and solve problems intuitively".

Felder-Silverman's Learning Style Index

In 1988 Felder and Silverman developed a learning style model that was designed particularly for use in engineering education. (Felder & Silverman, 1988). Learning was viewed as a "two-step process involving the reception and processing of information" (Felder & Silverman, 1988, p.674). The Learning Style Index model classified students according to their position on a

continuum that incorporates the way that the student prefers to perceive and process information.

The learning style model was defined by answers to four questions as described by (Felder & Brent, 2005, p. 60) below:

What type of information does the student preferentially perceive?

Sensory (external eg. sights, sounds, physical sensations), or *intuitive* (internal eg. possibilities, insights, hunches).

What type of sensory information is most efficiently perceived?

Visual (pictures, diagrams, flow charts, demonstrations), or *verbal* (written and spoken explanations)

How does the student prefer to process the information?

Actively (through engagement in physical activity or discussion), or *reflectively* (through introspection)

How does a student characteristically progress towards understanding?

Sequentially (in a logical progression of incremental steps), or *globally* (in a large "big picture" jumps).

The Index of Learning Styles® questionnaire was developed by Richard Felder and Barbara Solomon to assess preferences on the four scales of the Felder-Silverman model.

The VARK model

The learning style that has been adopted for the present research is the VARK model by Neil Fleming. It offers a fairly simple way in which to explain how students prefer to interact with the body of knowledge presented to them. It

was born as a result of Fleming's observation of how individuals reacted differently to a question like directing someone to a place/venue (Fleming & Baume, 2006). It parallels Gardner's Theory of Multiple Intelligences in which Gardner identified seven intelligence types or seven ways in which an individual can process information (Chapman, 2003-2009). Individuals tend towards an intelligence type and that tendency determines their preferred way of processing information. The VARK model is a shorter version of Gardner's Multiple Intelligence Theory and highlights the visual learning preference (linked to Gardner's spatial/visual intelligence type), the aural and read/write learning preference (linked to Gardner's linguistic intelligence type) and the kinaesthetic learning preference (linked to Gardner's bodily/kinaesthetic intelligence type). The VARK model highlights four sensory modalities that can be measured, and which serve as important intelligence types for health professionals to possess and be able to manipulate in their professional environment (Breckler, Joun, & Ngo, 2009). The visual learner is able to view the patient and interpret signs and signs and symptoms observed in order to make an informed diagnosis. Aural and read write cues empower the health science student to discuss conditions and treatment regimens with the patients and colleagues (aural) and to write professional patient reports (read/write). Lastly kinaesthetic learning is used in hands-on treatment of the patient either in terms of joint manipulation (Chiropractic), preparation of remedies (Homoeopathy) or positioning patients for and taking of x-rays (Radiography) to help in diagnosis and treatment of patient conditions.

The VARK model is an expansion of Stirling's (1987) VAK model (N. D. Fleming & Mills, 1992). Fleming found that the visual category in Stirlings' model was not sufficient to cater for more detailed differences that some students were displaying. The visual preference was therefore expanded to two modes viz. visual and read/write. The visual mode in VARK now catered for those students who preferred to see information in the form of diagrams, graphs

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and symbols while the read/write mode in VARK catered for the students who preferred to see information in the form of words and lists.

The table below explains the preferences of the VARK learning style preferences.

VARK mode	Definition	Resources
Visual (V)	Preference for diagrammatic material	Maps, flow charts, graphs, diagrams, models, highlighters, word pictures
Aural (A)	Preference for auditory or "heard" information	Lectures, taped sessions, group discussions, use of stories and jokes
Read/write (R)	Preference for written material	Textbooks, quotations, essays, reports, handouts, web pages
Kinaesthetic (K)	Preference for hands-on experiences	Dissections, prosections, simulations, demonstrations, case studies, constructing

Table 1: Explaining the VARK learning preferences (Adapted from Fleming, 1992; Hawk & Shah, 2007; Ramayah, et al., 2009)

A student may display either a strong preference for any one of the VARK modes and is described as having a unimodal preference, or may display a preference for two or more VARK modes simultaneously and is referred to as having multimodal learning preference. The student with a unimodal learning preference will need to have the information presented to him/her in the preferred form for understanding to occur. A student with a multimodal learning preference usually will need information presented in more than one form (sometimes all modes) for understanding to occur and hence may take longer to become confident in their learning. The advantage of multimodality as described by Fleming (2001-2010) is that they also have the ability to choose the mode(s) that they are most comfortable with or is most suitable in any given context, and can learn through that mode. It must be noted that the kinaesthetic learning preference was described by Fleming (1992) as being a multi-modal preference within a unimodality. Learning through experience and practice (as in the case of the kinaesthetic preference) requires the use of sight, hearing, taste, smell and touch.

The VARK learning style model was chosen as it not only provides a means of determining the learning preferences of the students but also provides the users, both students and academics with help in selecting strategies that would help to empower the students in their learning, and the teachers in creating a composite set of teaching strategies.

The VARK questionnaire is available online at http://www.vark-learn.com/english/page.asp?p=questionnaire . The VARK website is accessed by respondents from all around the world. The result from each respondent is stored in the VARK database together with demographic information that may have been supplied by the respondent. The VARK database is updated annually (last updated January 2010). Also included on the VARK website are the study strategies that have been devised by Fleming for each modal preference described by VARK.

Advantages of recognizing students' learning styles

Research in the field of teaching and learning over the past three to four decades have found that more effective outcomes were achieved when academics were aware of the learning styles of their student body (McKeachie, 1995). While learning styles cannot be aligned to student abilities or intelligence, knowledge of them may serve as a starting point for academics to try and understand why students find some learning experiences easier than others (Alkhasawneh, Mrayyan, Docherty, Alashram, & Yousef, 2008; Pheiffer, Holley, & Andrew, 2005) and may be used by educators to find informed solutions to student's learning problems and to empower the student to become more effective as a life-long learner (Allen, 2006; Baykan & Nacar, 2007).

To be of use to students, their various learning styles present must be discussed in class, so that students become aware of the diversity and see that they "may be different but not dumb" (Fleming, 1995, p. 310). Such enlightenment could allow them to use the correct strategies for their learning style thereby impacting positively on their personal growth and transformation in the education setting, which in turn can lead to retention in the programme (Bostrom & Lassen, 2006; Robotham, 1999).

Kumar, Voralu, Pani and Sethuraman (2009) assert that anyone can learn if their learning preferences are catered for in the teaching and learning environment. So it becomes crucial for the academic staff designing the teaching and learning strategies to accommodate the diverse learning styles as it has been found to improve student concentration and motivation.

Matched versus mismatched debate

Researchers are currently debating the matching versus mismatching of learning styles to teaching styles and its impact on student performance. The advocates of the matching theory include Felder & Silverman (1988), Heywood (2000), Zeeb (2004), Visser, McChlery & Vreken (2006) and Wehrwein, Lujan & DiCarlo (2007). All argue that matching learning styles of students with teaching styles leads to increased student engagement with the course which in turn leads to increases in student understanding, motivation and retention rates.

Opponents of the matching theory (Ayre & Nafalski, 2000; McKeachie, 1995), on the other hand, believe that students need to experience all styles of teaching so that they can overcome weaknesses in their own learning style and develop a more holistic approach to learning. However, researchers are fairly unified in their belief that matching of student learning styles to the teaching style is particularly effective for the first year student (McKeachie, 1995; Meehan-Andrews, 2009) who having to deal with the Higher Education environment and all its uncertainties, would be assisted if initially taught in his/her comfort zones.

Gender differences in learning styles

According to Restak (1979), boys and girls think differently from each other and these behavioural differences are based on "differences in brain functioning that are biologically inherent and unlikely to be modified by cultural factors alone" (p. 233). Girls from infancy have been found to be more aural and in possession of greater fine motor abilities, while boys have been found to be more visual and more able to excel in activities that required full body co-ordination (Restak, 1979). A study conducted with Armenian, African, Hispanic, Hmong, Korean, Mexican and Anglo students in a secondary school setting by Park (2001) found no gender differences between aural and visual

learning. However while kinaesthetic learning style was the preferred mode of both genders, the females were noted to exhibit a greater preference for kinaesthetic learning style than the males. More recently Wehrwein et al (2007) in a study conducted among undergraduate Physiology students, observed that a greater percentage of males were multimodal while a greater percentage of females were observed to be unimodal. This finding however is in contrast to a study by Slater et al (2007) conducted among first year medical students, which reported no significant differences between gender and learning styles. Slater et al (2007) observed that while both males and females preferred multimodal learning styles, the females among the students exhibited a greater diversity (10 of the possible 11 combinations) within the multimodal preferences while male students identified with a smaller subset (six of the possible 11) of multimodal preferences.

While no consensus seems to exist in the studies investigating the relationship between gender and learning styles, Severiens and Dam (1997) point out that understanding the impact of gender on the educational process is important as this understanding could possibly lead to changes that would "create gender equality in educational practice" (unpaginated).

Teaching styles

Teaching/formal education has travelled a long road since the days of being viewed simply as a means of information transfer from the teacher to the student who was viewed as a blank slate waiting to absorb the information. If the student struggled or failed to absorb the information being presented s/he was deemed ignorant, lazy or unmotivated. Recent changes in the characteristics of the university classes have forced academics to take a fresh look at the teaching strategies being employed and to question whether this strategy is the most suitable to cater for the diverse needs of the student

population (Biggs, 1999). While a single best method for teaching does not exist, an effective and wise teacher would employ dynamic teaching strategies that would be suitable for the subject content delivery while also taking into cognisance the strengths of the students and her own strengths and weaknesses (Biggs, 1999; Brown & Atkins, 1988). In essence to teach effectively requires one to have content knowledge, skills on how to teach and knowledge about how the students learn or interact with the knowledge.

Chickering and Gamson (1987) proposed the following as activities of good practice in undergraduate education:

- encourages contact between students and faculty,

- develops reciprocity and co-operation among students,

- encourages active learning,

- gives prompt feedback,

- emphasises time on task,

- communicates high expectations, and

- respects diverse talents and ways of learning

The main theme running through these activities of good practice is that the process involves communication, respect and encouragement both among students and between the student and the lecturer.

Assessment styles

Most of the research investigating the link between student learning styles and teaching styles, have resorted to assessing student performance using the

traditional methods of assessment. Osborn and Plunkett (2003) observe that while innovative teaching methods appear to be positively correlated with students' performance, such results become questionable when traditional summative assessments are employed. Buxeda and Moore (December 1999/ January 2000) state that the introduction of new methods of teaching would necessitate the use of a matching set of assessments. This is especially true if the new teaching methods are designed to address specific issues like student learning styles. Brown and Glasner (1999, p. 7) describe assessment as "the cash nexus of learning" and assert that changes to student learning must be coupled with a change in the assessment method.

Ramayah et al (2009) provide a useful guideline for the assessment of students with the VARK learning preferences viz. that visual learners should be allowed to draw things or represent their answers in a diagrammatic form, aural learners should be given the opportunity to showcase their understanding by allowing them to speak their answers out to the examiner in the form of an oral assessment, read/write learners prefer to write essays, lists and answer multiple choice questions and finally the kinaesthetic learner can demonstrate his knowledge acquisition by being tested in the laboratory with the actual specimens or in role playing a clinical scene. These guidelines form the basis of the development of the assessment techniques used in the current research.

Framework for aligning teaching, learning and assessment
Constructive alignment is a term introduced by Biggs in 1999 (Houghton, 2004) which incorporates how students interact with information and the design or alignment of the teaching and assessment methods.

Bigg's created a "3P" model of learning which forms the conceptual framework for this study. The 3P model involves:

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Presage: incorporates what a student brings with him/her into the learning environment e.g. learning preference.

Process: deals with the instructional design and the assessment method i.e. the manner in which the information will be disseminated and the assessment method to be used to determine the final outcome.

Product: deals with the final outcome viz. the student performance resulting from the specific intervention.

The product will then be analysed with reference to the presage and process components of the model for each intervention and patterns will be inferred from the results.

The student learning preferences will be used to guide the teaching and assessment methods used in the classroom. The results obtained from the assessments, will then be analysed to determine whether patterns (in the student performance) exist when the student learning preferences, teaching methods and assessment methods are matched or correlate with each other. The model incorporates an interaction between the three parts, with each part feeding into or driving the other and affecting the final outcome. Freeth and Reeves (2004, p. 54) stated that Bigg's 3P model of learning and teaching should be an active process for educators and curriculum designers as it is important for process to be in touch with and respond to the presage. Houghton (2004; unpaginated) stated that constructive alignment "is about getting the students to take responsibility for their own learning" and the teacher "to create an environment which is encouraging and supportive of students engaging in the appropriate and necessary mental activity."

Prosser and Trigwell (1999, p. 173) also highlight the link between understanding how students perceive information and the impact on the learning experience. They stress that university teachers need to be mindful of

"the way their students perceive the learning and teaching situation". In light of this awareness educators need to "continuously revise, adjust and develop" their teaching strategy.

Current research on learning styles

At least eight of the studies conducted in the last six years to investigate the learning styles of students studying the basic medical science subjects (mainly Physiology), have used the VARK questionnaire or an adaptation of the VARK questionnaire. The VARK questionnaire was used by the studies conducted by Alkasawneh et al (2008), Baykan & Nacar (2007), Breckler et al (2009), Murphy, Gray, Straja & Bogert (2004), Slater et al (2007) and Wehrwein et al (2007). These studies were conducted using undergraduate students. The studies by Dobson (2009) and Mitchell, Xu, Jin, Patten & Gouldsborough (2009) did not use the VARK questionnaire but created their own questionnaires based on the VARK sensory modalities.

Three of the studies (Alkhasawneh, et al., 2008; Slater, et al., 2007; Wehrwein, et al., 2007) investigated the link between gender and learning styles using the VARK questionnaire. Slater et al (2007) and Alkhasawneh et al (2009) found that although most of the students exhibited a multimodal learning preference, no significant difference existed between gender of the students and their learning styles. Wehrwein et al (2007) however found that a greater percentage of females exhibited a unimodal learning preference while a greater percentage of males exhibited a multimodal learning preference. The study conducted by Dobson (2009) found statistical differences between male and females in terms of learning styles, however these were limited to unimodal differences as the questionnaire (adapted from VARK) that was used in this study did not allow for the choice of multiple sensory modalities.

The study conducted by Dobson (2009) used a specific teaching strategy incorporating multiple teaching resources for the study to investigate the link

between the teaching and learning styles. The teaching strategy consisted of a lecture component and a laboratory session. At the end of the session the students were asked to evaluate which parts of the teaching strategy namely the lecture component or the laboratory session was more helpful in their learning. Alkhasawneh et al (2009) introduced a problem based component and compared the student course marks with their learning styles.

All of the studies have highlighted the advantages of gaining knowledge of student's learning styles and using this knowledge to develop teaching methods. Some of the studies have advocated matching learning styles with teaching methods (Baykan & Nacar, 2007) and others (Mitchell, et al., 2009) have advocated a balance between matched and mismatched teaching and learning styles. While some of the research conducted thus far has investigated the link between different teaching methods and the learning styles, the assessment methods used to determine student performance have continued to use the traditional method.

My study has separated the VARK learning preferences and developed teaching and assessment methods accordingly. The students will be assessed using both paragraphs (read/write) and diagrams (visual) to investigate the link between learning styles and teaching and assessment styles.

The next chapter describes the methods used to determine the learning profiles of the Anatomy students. It also explains three different teaching and assessment modes that were designed and put into action to explore whether the students were more successful when the teaching and assessment methods were matched with their identified learning styles.

CHAPTER THREE

METHODS AND METHODOLOGY

In seeking to determine the learning styles of my first year anatomy students and to explore the effects of matching my teaching and assessment styles to the students' preferred way of learning, I embarked on a study which is described in this chapter.

Research design

Cohen, Manion and Morrison (2007, p. 5) described research as being about the researcher's personal understanding of the world, how s/he perceives the world and the meanings the researcher makes from this understanding. Therefore in order to make sense of the research design, the researcher needs to state his view of reality and his understanding of the nature of that reality. The research was contained within a post-positivist paradigm as it sought to discover truths which were assumed to be in existence but recognized that the researcher and the students had an impact on each other.

This research was an exploratory study that aimed at determining the learning style profiles of the first year anatomy students at a University of Technology, introducing different teaching and assessment methods and exploring the relationship between student learning styles, teaching and assessment methods and student success rates. The researcher employed a quantitative approach using a learning style questionnaire and a number of different teaching and assessment scenarios, the results of which were analysed using a statistical package. The researcher then inferred relationships based on the results obtained from the data.

Selection of participants

The purpose of the research was to acquire a deeper understanding of the learning styles of the students and to explore the impact of various teaching and assessment methods on the success rates of the students. Hence, a purposeful type of non-probability sampling was employed. This method of sampling is used "in special situations where the sampling is done with a specific purpose in mind ….." (Maree, 2007, p. 178).

Sixty-eight first year anatomy students were selected to participate in this study. These students were chosen to participate because their anatomy curriculum could be used to incorporate the VARK teaching strategies. Another determining factor for the researcher was the accessibility of these students to the researcher i.e. they formed part of the researcher's teaching allocation and therefore were easily accessible.

Access to site and ethical clearance

Permission to conduct the research was sought and obtained from the Deputy Vice Chancellor of the academic ambit of the University of Technology in which the study was to be conducted. The permission letter is included as appendix A. Because VARK is a registered learning styles questionnaire, permission was sought and obtained from the creator of the VARK learning style questionnaire, Neil Fleming. His response is included as appendix B.

Ethical clearance for the project (ethical clearance approval number HSS/0780/09M) was obtained through the University of KwaZulu-Natal Research office. The ethical clearance approval form is included as appendix C.

Once access and permission had been granted to conduct the research, the students were approached and informed of the purpose of the study. The

students were informed of the selection criteria being used, that participation in the study was voluntary and confidential, and that participants were free to withdraw at any time without prejudice (Cohen, et al., 2007; Graziano & Raulin, 2004). The student information letter and informed consent slip are included as appendix D. The participants were also assured that all data collected would be stored in a secure place and would only be accessible to the researcher. Informed consent was then obtained from all participants.

Student participation in the study was voluntary but because student performance was tracked, the student questionnaires could not be anonymous. However all the results of the research were kept electronically by the researcher, secured in a password protected file. The result obtained from the VARK questionnaire submission was discussed with each student individually. The teaching and assessment interventions affected a small component of the anatomy 1 curriculum and it was not envisaged to disadvantage the students. If a student(s) required the sections (organs) to be repeated, this was done to ensure that no student was disadvantaged for the purpose of the research. This was only requested once during the research by two students. I did a further explanation of the organ in question and the students understood and were satisfied.

Data Collection

Aim 1: Profile the learning styles of the first year anatomy students
In order to determine the learning styles of the individual students, each student had to complete the VARK questionnaire which is available online at http://www.vark-learn.com/english/page.asp?p=questionnaire. A printed copy of the VARK questionnaire is attached as appendix E.

About VARK

The VARK questionnaire consists of 16 multiple choice questions which are based on real-life experiences rather than hypothetical settings (Slater, et al., 2007). These questions can be completed in a short time. The questions deal with how the student prefers to receive information (question numbers 2, 4, 7, 8, 9, 1 and 13), process information (question numbers 6, 10, 11 and 12) and disseminate information (question numbers 1, 3 and 5) (Fleming & Mills, 1992). Four of the sixteen questions have three options while the remaining questions have four options from which to choose. Each of these options match a sensory modality i.e. visual, aural, read/write and kinaesthetic. The user may choose more than one option in a question or leave the question blank. The former situation is encouraged for questions dealing with situations that are out of the student's field of experience (Fleming & Mills, 1992). The questionnaire was deliberately designed to be short so as to be user friendly and avert student apprehension in taking the survey. Once the online version of the questionnaire had been submitted, it was almost immediately returned with the student learning profile reflected as four scores- one for each modality. The student was advised as to the type of learning preference that they displayed based on their responses. The result sheet also directed the student to study strategy help sheets (available from the VARK website) designed per modality.

Piloting VARK

The online version of the VARK questionnaire was piloted with a class of first year Anatomy students who were not part of the study. The researcher secured four staff computers in the department of Basic Medical Sciences from which the VARK website was accessed. The students were given guidelines for filling in the questionnaire and were then left to complete the VARK questionnaire in private. The students then submitted the online version and received a response from the website which was printed and examined by the student for verification. The students in the pilot group managed to complete the questionnaire and receive responses in a time frame of between five and ten

minutes. The students in the pilot group indicated that learning preferences identified by the VARK website were a true reflection of the way in which they prefer to work with information.

Determining student learning preferences

It was initially envisaged that the students would access the VARK questionnaire online in the Faculty of Health Sciences computer laboratory. However, accessing the computer laboratory proved to be difficult due to the limited booking time available to the researcher and the inability to match the students' academic timetable with the times when the computer laboratory was available. The researcher then printed a copy of the VARK questionnaire from the online database. Copies of the questionnaire were made and handed out to the students for completion. The students were informed at this stage, that they could choose more than one option per question or they could leave a question blank. The completed forms were then collected by the researcher. All 68 participants completed and returned the questionnaire. The researcher then loaded each student's responses individually onto the online version of the questionnaire on the VARK website. The responses were submitted and an electronic result was immediately returned for each student. Loading each student's responses on the online version of the questionnaire had to be done with extreme care as the order of the questions changed each time the online questionnaire was accessed. The electronic result was immediately copied and pasted onto a participant verification form (included as appendix F) which was then attached to the student's copy of the questionnaire.

The VARK questionnaires are usually completed anonymously. This created a limitation in a previous study in that the researchers were not be able to make "definite conclusions that link a particular observation of student actions or performance to a type of learning style" (Wehrwein, et al., 2007, p. 156). For the purpose of this study, the questionnaire could not be completed

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anonymously as the second part of the study aimed to determine if patterns existed when the teaching and assessment styles were matched to learning styles of students. Therefore, in order to establish if patterns existed between matched and mismatched teaching and assessment styles, individual student marks had to be tracked. The results were returned to the individual students in class. The VARK profiles were explained to the students and each of them was asked to complete the VARK verification form attached to each of their results sheet. The verification page requested the student's name, age and sex and a place for the student to indicate whether they agreed or disagreed with the result obtained from the VARK questionnaire. One hundred percent agreement was obtained from the students.

Aim 2:   Explore students learning outcomes using matched and unmatched teaching and assessment methods

Three separate teaching and assessment methods were designed to explore whether student performance was affected by matched or unmatched teaching and assessment styles. All the teaching and assessment methods were designed based on the strategies identified by Fleming on his VARK website as to the way in which students with different modalities prefer to receive, process and disseminate information. It was initially envisaged that the teaching methods would be unimodal (visual, read/write and kinaesthetic) but it was later noted that any lecture or formal classroom environment would of necessity involve the aural mode and so the first method of teaching described was a combination of the aural and read/write modes and the second teaching method described is a combination of the aural and visual modes. Unfortunately due to the small number of specimens/organs available to us for teaching purposes, the kinaesthetic method of teaching had to be excluded. This was done since all students would not have been able to access the specimens of each organ at the

same time. The third teaching method used was a combination of the aural, visual and read/write sensory modes. While the first two teaching methods appear to be bimodal (i.e. aural and read/write and aural and visual), the emphasis on the lecture presentation and notes were unimodal. For the aural and read/write teaching method, the notes were in a short note format with no diagrams. In the aural and visual teaching method, the notes provided to the students contained diagrams only and no written notes. All the teaching and assessment was conducted by the researcher who was the lecturer of the course.

All students were taught using each of the three teaching methods and they were assessed at the end of the each session using an assessment tailored to the same modality as that predominantly employed in the teaching method.

The aural mode was present in each teaching method as explained earlier so to avoid repetition, a short description of the aural mode follows. As described in chapter two, aural learners prefer to attend classes and listen to what is being said in class. They also prefer to discuss topics with the teacher and colleagues to ensure understanding of the information presented.

Aural and Read/write teaching and assessment mode

As described in chapter two, read/ write learners learn through interacting with material that is rich in text (Lujan & DiCarlo, 2006) and they like "teachers who use words well and have lots of information in sentences and notes (Fleming, 2001).

The large intestine was the organ chosen for this teaching and assessment method. In keeping with the strategies suggested by Fleming (2001-2010) for the read/write learning preference, the students were provided with comprehensive notes on the large intestine, its characteristics, parts and blood supply. The lecturer copied these comprehensive notes onto an overhead transparency. During the lesson, the overhead projector was used to display the

notes onto a wall in the lecture room. The lesson was taught by explaining each point as it appeared on the screen.

The focus of this teaching mode was on the written word, so no diagrams, highlighters or animations were used. The lecturer also refrained from using any demonstrations during the lesson. During summary of the lecture, key words were written out on the board at the front of the class and the lesson was summarized by linking these words with each other.

The students were given ten minutes at the end of the lesson to review the work that was delivered for the lesson. The students were then assessed to ascertain the level of understanding of the lesson using the read/write mode. The assessment was a short ten minute test, in which the student was asked two questions. One was to explain the parts of the large intestine and the second was to explain the blood supply of the large intestine. Since this was the read/write mode, the students' answers had to be in the form of a discussion paragraph i.e. no diagrams could be used to formulate the answer.

Aural and Visual teaching and assessment method

As described in chapter two, the student with this learning preference prefers to receive information in the form of diagrams, flow charts and other teaching tools rich in images (Fleming, 2001; Lujan & DiCarlo, 2006)

The stomach was the organ chosen for this teaching and assessment method. A powerpoint presentation using Microsoft version 2007 was employed. The presentation consisted of a number of slides with colour diagrams and photographs of the actual organ. The slide presentation was custom animated to highlight the various parts of the stomach using block highlights and arrows that moved onto the diagram as the part was being taught. The surface anatomy

of the stomach was added onto each part as it was highlighted. The blood supply of the stomach was explained using the wipe function in custom animation. As each blood vessel was being taught, the blood vessel was highlighted from its point of origin and followed through to its area of supply using the wipe function. The white board was also used to summarise the lesson, with the aid of flow diagrams. The parts of the stomach, its surface anatomy, and its blood supply were summarized on the white board at the end of the lesson using a variety of coloured markers.

In keeping with the strategies suggested by Fleming (2001-2010) for the visual learning preference, the students were provided with two A4 pages at the beginning of the lesson containing diagrams of the stomach. These diagrams are included as appendix G. The first page contained a black and white picture of the stomach. During the lesson, the student was asked to mark off the various parts of the stomach using coloured pencils or coloured markers and to label the parts as they were highlighted. The surface anatomy of each part of the stomach was added to the diagram by the student. The second diagram contained a black and white picture of the stomach and the blood vessels associated with the stomach. Besides the black and white drawing of the stomach, there were no other markings on the page. As part of the lesson, the student was required to highlight each blood vessel as they were mentioned, with a coloured marker or highlighter and to follow the blood vessel from its origin to the area of supply on the stomach. In this way, by the end of the lesson, the student had two picture notes explaining the parts of the stomach, its surface anatomy and the blood supply.

The students were given ten minutes at the end of the lesson to review the work that was delivered for the lesson and then were given a short test to ascertain the level of understanding of the lesson using the visual mode. The assessment was a short ten minute test, in which the student was asked two questions. One was to explain the parts and surface anatomy of the stomach and the second

was to explain the blood supply of the stomach. However, since this was the visual mode, the answers to the questions had to be in the form of a diagram or flow diagram drawn by the student.

Aural, visual and read/write teaching and assessment method

From the results obtained in the first part of the research, it was evident that most students in the class were multimodal learners i.e. they require more than one sensory mode to be used in information reception. To accommodate these students, the lecturer presented this lesson, using a combination of three of the four sensory modalities viz, visual, read/write and aural.

The heart was the organ chosen for this multimodal teaching and assessment mode. The lecturer utilized a mixed bag of teaching aids. The students were provided handouts that contained detailed notes of the heart, its parts, surface anatomy and blood supply. Also contained in these notes were diagrams of the heart, its parts, surface anatomy and blood supply. The lesson began by reviewing the notes on the overhead projector in which the parts of the heart, its surface anatomy and blood supply were discussed. This was then followed by a powerpoint presentation using diagrams which were labeled and highlighted using the custom animation function to show the parts of the heart and its surface anatomy. A powerpoint presentation was also used to illustrate the blood supply of the heart using diagrams, highlights and custom animation to follow the blood vessels from its origin, along its course to its areas of distribution.

The students were given ten minutes at the end of the lesson to review the work that was delivered for the lesson and then were given a short test to ascertain the level of understanding of the lesson using the multimodal teaching method. The assessment was a short ten minute test, in which the student was asked two

questions. In the first question, the student was asked to explain the parts and surface anatomy of the heart and in the second question, was asked to explain the blood supply of the heart. However in keeping with multimodal theme, the students were allowed to choose which mode they preferred to express their answers to the questions i.e. the students could write the test answers in the form of paragraphs or in the form of drawings or flow diagrams. It was initially envisaged to add an oral as an option for answering the questions but due to time constraints the oral response using the specimen on which they could demonstrate the answers to the questions had to be abandoned.

Analysis of results

The tests from all three teaching and assessment methods were marked and the results were analysed using the Pearson correlation coefficient, chi square test and the t-test.

The Pearson correlation coefficient is used when "we want to quantify the strength of the relationship between two or more variables, which indicates the degree to which the two scores tend to vary together."(Graziano & Raulin, 2004, p. 111). Hence this test describes the relationship between the learning preference of the student and the teaching and assessment mode being employed.

However as Graziano and Raulin (2004) point out, that when the research study is comparing three or more groups, an additional test is required to determine where the significant difference lies. This additional test is the t-test which "evaluates the size of the difference between the means of the two groups" (Graziano & Raulin, 2004, p. 237). The chi square test is a non-parametric test used when the researcher wants to investigate the relationship between two

nominal variables (Maree, 2007) e.g. learning styles and teaching and assessment methods.

Limitations of the study

While a recent study conducted by Leite, Svinicki and Shi (2010) has reported preliminary evidence for support of the use of the VARK questionnaire as a diagnostic tool, its use as a research tool was not wholly supported. However its use for the purpose of the research is not to develop categories with which to label students but rather to serve as catalyst for discussions on the diversity of the student body and the suitability of the design of the teaching and learning environment to optimally cater for this diversity.

Students may have felt disadvantaged by the teaching method for certain organs. The researcher overcame this by repeating the lesson and instituting tutorials so that the individual's overall performance was not jeopardised.

The research design was not sufficiently complex to accommodate the use of a variety of educators and therefore the researcher was the facilitator in all the teaching and assessment interventions. The findings of this research whilst being context specific may be a useful contributor to the debate on the matched versus mismatched teaching and learning styles and its impact on student performance.

The methodology may not be transferable to other courses. With any learning style/ teaching method intervention, the results and methods used are dependent on the current student body. Therefore while the entire methodology may not be transferrable, the findings that emerge from this study can certainly be used as a guide by other educators to feed into their future curriculum design.

This chapter has detailed the process which the research study followed. In the next chapter, the results of the VARK questionnaire will be presented in the form of graphs and the results from the tests following each of the three teaching and assessment methods used will be presented and analysed.

CHAPTER FOUR

RESULTS

In this chapter, the results of the research will be presented in two phases.

Phase one will be the presentation of the results pertaining to the following research questions:

- What are the learning styles of the first year anatomy students?

- Is gender associated with learning style?

The findings derived from the VARK questionnaire will be presented in response to the questions above. The findings of this research will also be compared with that of the other research in a similar setting and with the results on the VARK website.

Phase two will be the presentation of the results pertaining to the following research question:

- Does matching student learning styles to teaching and assessment styles affect student performance?

The findings derived from the three teaching and assessment modes used namely the aural and read/write mode, the aural and visual mode and a combination of the aural, read/write and visual modes will be presented and analysed.

In an attempt to engage with as many sensory modalities as possible, the results will be presented in the read/write and visual modes i.e. in the form of paragraphs and with the use of tables and graphs.

PHASE ONE: **Profile the learning styles of the first year anatomy students.**

Learning style profile of first year anatomy students

Sixty-seven of the 68 students recorded on the anatomy register completed and returned the VARK questionnaire resulting in a 98.5% response rate. The results of the questionnaire analysis are presented below.

The data collected from the VARK questionnaire suggest that the majority (64%) of the first year anatomy students displayed a multimodal learning preference while the remaining 36% of the students displayed a unimodal learning preference. Figure 2 illustrates the percentage of students who preferred their information to be presented in multiple modes and the percentage of students that preferred their information in a single mode namely visual (6%), aural (1%), read/write (13%) and kinaesthetic (15%).
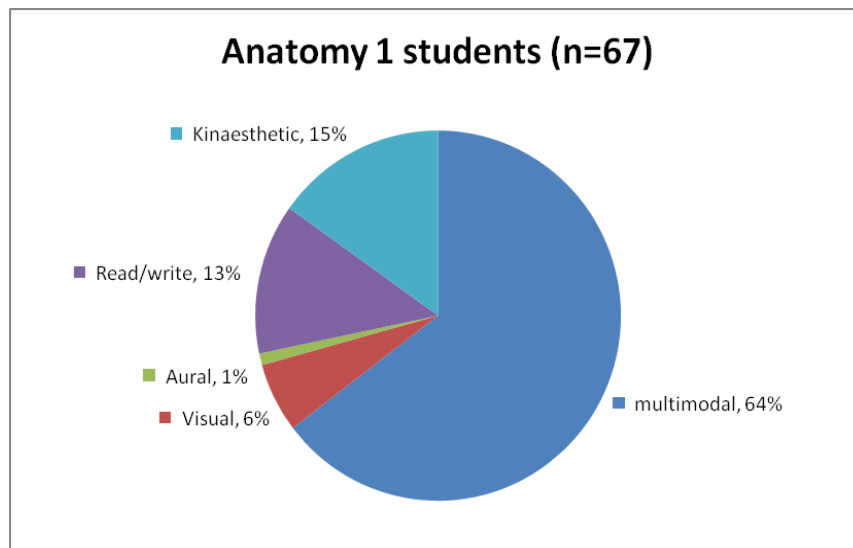

Anatomy 1 students (n=67)

Kinaesthetic, 15%
Read/write, 13%
Aural, 1%
Visual, 6%
multimodal, 64%

Figure 2: Distribution of unimodal and multimodal learning styles among first year anatomy students

Of the 43 students that preferred their information presented in multiple modes, some students (as illustrated in figure 3 below) preferred two modes of presentation (bimodal 16%), some students preferred three modes of presentation (trimodal 28%) and the majority of students preferred four modes of presentation (quadrimodal 56%).
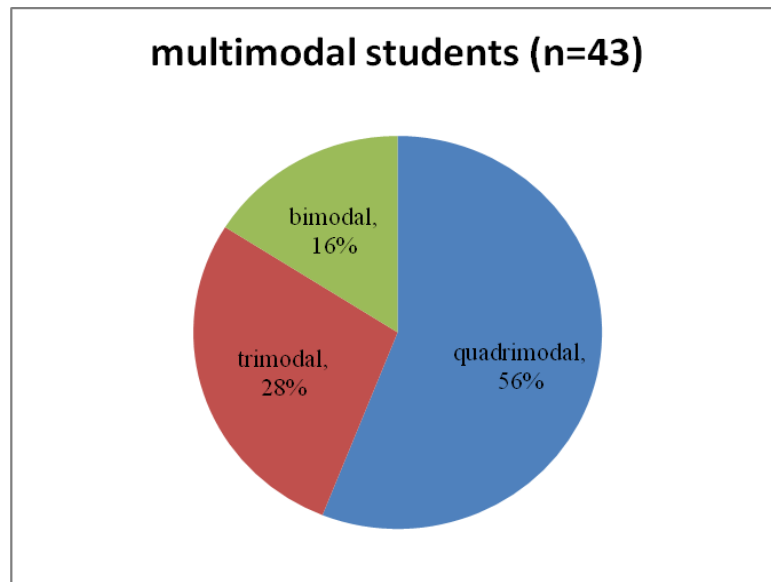
Figure 3: Distribution of multimodal learning styles among first year anatomy students

A variety of multimodality combinations emerged amongst the first year anatomy students displaying trimodal and bimodal preferences. The most popular combination of trimodality was recorded as those students who preferred the aural, read/write and kinaesthetic modes (ARK=16%), followed by students who preferred the visual, read/write and kinaesthetic modes (VRK = 9%) and the least popular trimodality was the combination of the visual, aural and kinaesthetic modes (VAK = 5%). Only three of the possible six

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combinations of bimodality available were recorded as preferred modes by the students in this study. The most popular bimodality combination recorded was those students who preferred the read/write and kinaesthetic modes (RK=9%), followed by those students who preferred the aural and kinaesthetic modes (AK=5%) and then the students who preferred the visual and kinaesthetic modes (VK=2%). These combinations are illustrated in figure 4 below.
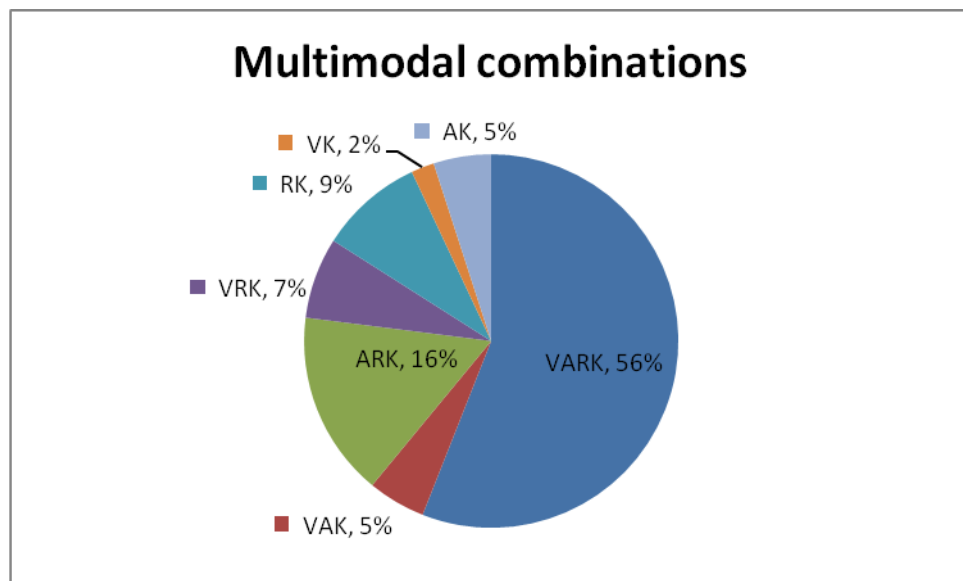
Figure 4: Distribution of multimodal learning style combinations among first year anatomy students

Gender differences in learning style preferences

The results of the VARK questionnaire were analysed for gender differences among the first year anatomy students participating in the study.

Of the 67 participants in this study, 48 were female and 19 were male. Thirty-two of the 48 female students and 11 of the 19 male students generated a

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multimodal learning preference while 16 female students and 8 male students preferred unimodal styles of information transmission. Figure 5 below, highlights the percentages of male and female students who preferred multimodal and unimodal information presentation styles. 67% of the females in this study preferred information to reach them through multiple sensory modes compared to 58% of the males in the study. The remaining females (33%) and males (42%) in the study preferred the use of single sensory modality in processing information.
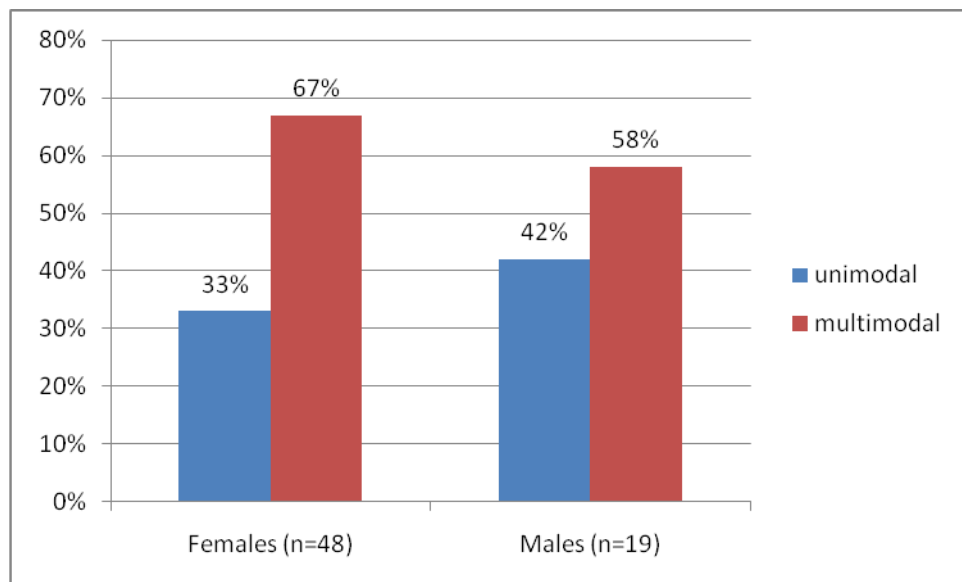

Figure 5: Gender differences in the distribution of unimodal and multimodal learning styles

Figure 6 and figure 7 illustrate the breakdown of the unimodal, bimodal, trimodal and quadrimodal learning preferences by gender. As illustrated by figure 6, the quadrimodal learning preference was evenly distributed between the genders with the males at 55% and the females at 56%. The greater

percentage of bimodal preference occurred in the female students (19%) as compared to the male students (9%). The opposite was true for the trimodal preferences which were favoured by the greater percentage of male students (36%) as compared to the female students (25%). Of the six possible bimodal combinations viz VA, VR, VK, AR, AK and RK; three combinations were recorded among the female students in this study viz. RK (9%), VK (3%) and AK (6%) while only one combination was prevalent among the male participants viz. RK (9%). Only three of the possible four trimodal combinations were presented by the female participants viz. VAK (3%), ARK (13%) and VRK (9%) while only two of the possible four trimodal combinations were present among the male student participants viz. VAK (9%) and ARK (27%).
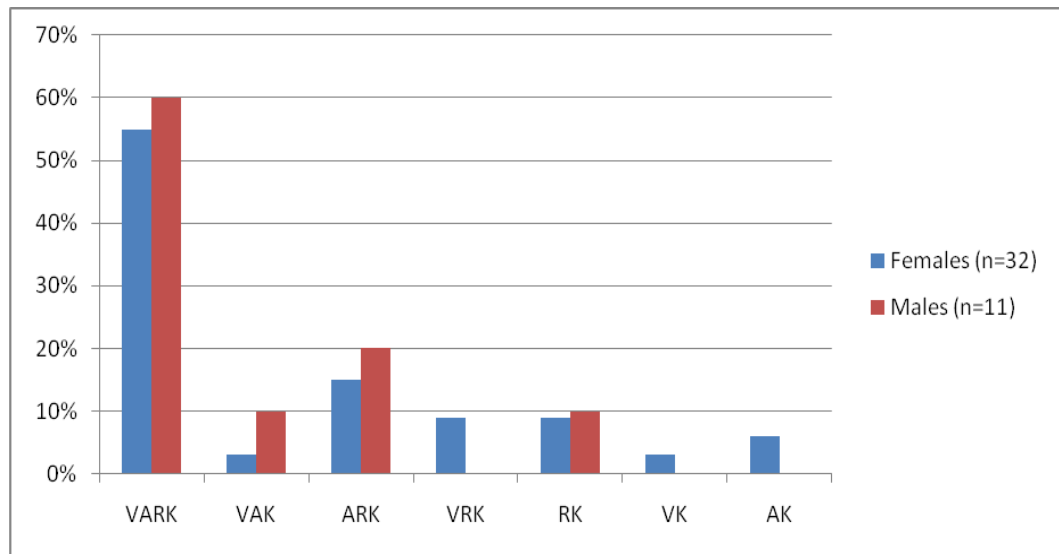

Figure 6: Gender differences in the distribution of multimodal learning styles among first year anatomy students

As illustrated in figure 7, of the students who preferred a single mode of information presentation, the females displayed a greater tendency towards the

read/write (15%) unimodal preference followed by the kinaesthetic mode (10%). The males showed a greater tendency towards the kinaesthetic (26%) unimodal preference followed by the read/write mode (11%). Both genders displayed a low (2% females) or non-existent (0% males) unimodal aural preference. Six percent of the females and 5% of the males exhibited a unimodal visual preference.
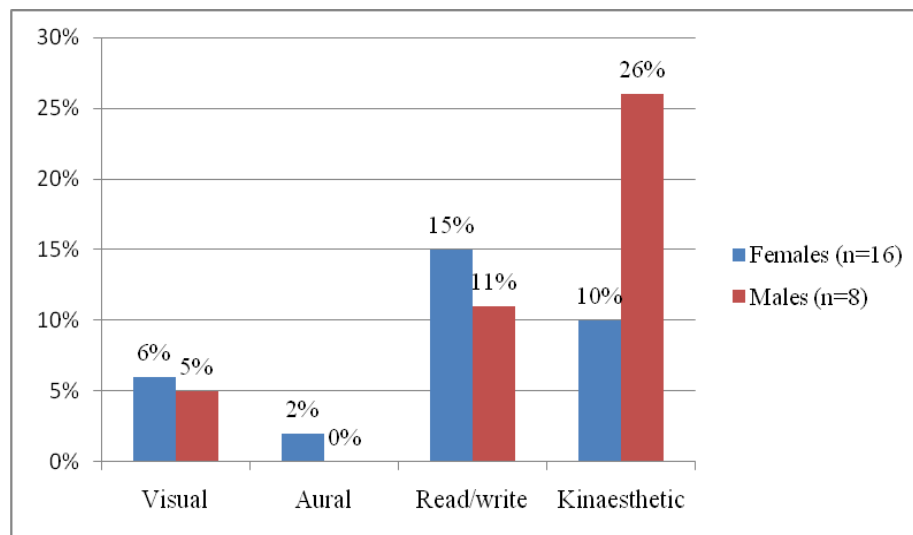
Figure 7: Gender differences in the distribution of unimdoal learning styles among first year anatomy students

Comparison with other studies

The results obtained in this study compared favourably (as illustrated in figure 8) with the results of the VARK website as of January 2010 (as explained in chapter two) and other studies in the health sciences using the VARK questionnaire. The distribution of students that favoured the multimodal preference (64%) and unimodal preference (36%) was identical to the results obtained on the VARK website, the study conducted by Lujan and

DiCarlo(2006) and the study conducted by Baykan and Nacar (2007). A slight variation occurred in the study conducted by Slater et al (2007) in which the multimodal preference was recorded by 56% of the students and the unimodal preference by 44% of the students.

Of the students that preferred the unimodal transmission of information, the kinaesthetic mode was the most popular choice by all the studies except for the VARK website. The read/write preference was the second most favoured single mode except for the Baykan & Nacar study which recorded the read/write mode as the least favoured mode and the aural mode as the second most favoured mode. In the remaining studies, the participants recorded the lowest preference for the visual and aural modes, as was the case in my study.
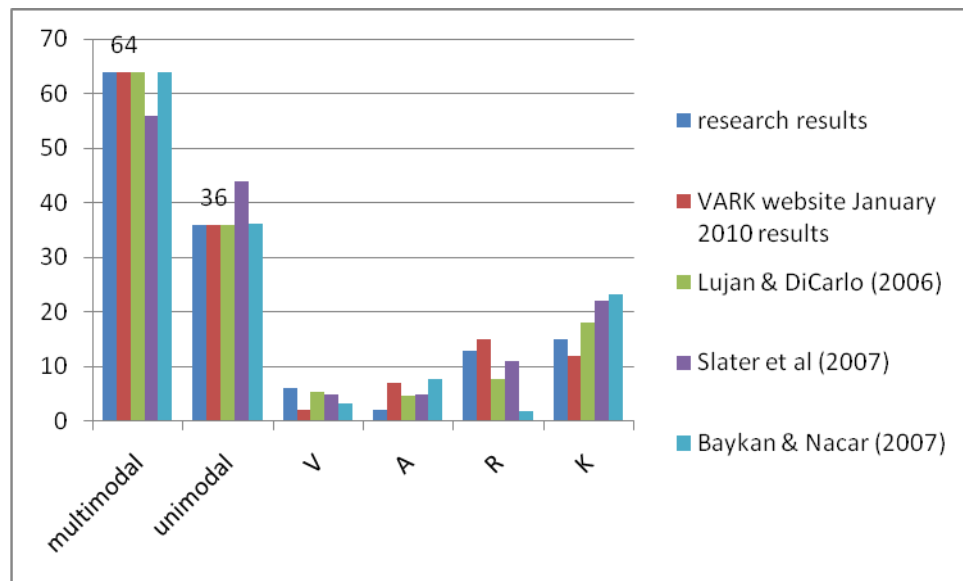

Figure 8: Comparison with results from similar studies and the VARK website

PHASE TWO: **Explore students' learning outcomes using matched and unmatched teaching and assessment methods.**

Sixty-three of the class of 67 students attended the aural and read/write teaching and assessment method, 56 of the 67 students attended the aural and visual teaching and assessment method and 59 of the 67 students attended the aural, read/write and visual teaching and assessment methods. The assessments from each of the three teaching methods were marked and the marks were entered onto an Excel spreadsheet per method. The table below is a summary of the marks achieved by the learners for each learning style when different teaching and assessment methods were used.

Table 2: Summary of mean scores of learning styles per teaching method

Classification		Method 1	Method 2	Method 3
A	Mean	30.00	15.00	.00
	N	1	1	1
	Std. Deviation	.	.	.
AK	Mean	53.50	55.00	74.00
	N	2	1	1
	Std. Deviation	26.163	.	.
ARK	Mean	67.14	71.25	29.17
	N	7	4	6
	Std. Deviation	14.531	16.520	4.622
K	Mean	52.20	61.25	35.88
	N	10	8	8
	Std. Deviation	18.576	17.718	16.660
R	Mean	51.25	49.67	27.11
	N	8	9	9
	Std. Deviation	13.615	25.860	21.009
RK	Mean	53.25	68.00	32.50
	N	4	3	4
	Std. Deviation	10.210	30.000	13.820
V	Mean	47.25	53.00	16.00
	N	4	3	3
	Std. Deviation	12.285	22.913	8.888
VAK	Mean	72.00	55.00	4.00
	N	1	2	1
	Std. Deviation	.	35.355	.
VARK	Mean	68.86	63.00	30.52
	N	22	22	23
	Std. Deviation	15.047	23.483	16.484
VK	Mean	52.00		20.00
	N	1		1
	Std. Deviation	.		.
VRK	Mean	60.67	42.67	20.50
	N	3	3	2
	Std. Deviation	15.011	6.429	4.950
Total	Mean	59.71	58.55	29.24
	N	63	56	59
	Std. Deviation	16.874	22.974	17.144

The percentage of students (per learning style) that passed in each of the three teaching and assessment methods, is presented in figure 9 below. From the graph, it can be observed that students with the AK, ARK, K, R, VAK, VARK, VK and VRK learning styles passed the assessment following the aural and read/write (AR) teaching method. Students with the AK, ARK, K, R, RK, V, VAK and VARK learning styles passed the assessment following the aural and visual (AV) teaching method. Only students with the AK learning style passed the assessment following the visual, aural and read/write (VAR) teaching method. The dominant learning style emerging from these results appears to be the kinaesthetic mode, both as a unimodal learning preference or as part of a multimodal combination.
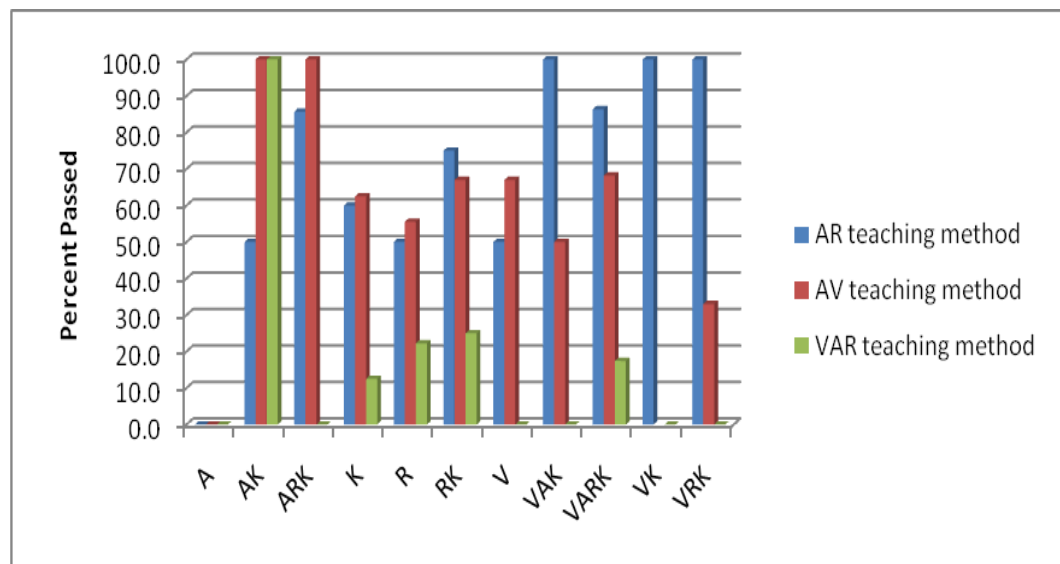

Figure 9: Performance patterns of learning styles per teaching and assessment style

To determine whether there were any correlations between the scores achieved, Pearson's correlation coefficients were determined. The results are presented in the table below.

50

Table 3: Results of Pearson's correlation co-efficient tests

		Classification	Method 1	Method 2	Method 3
Classification	Pearson Correlation	1	.291*	.043	-.094
	Sig. (2-tailed)		.021	.753	.477
	N	67	63	56	59
Method 1	Pearson Correlation		1	.434**	.294*
	Sig. (2-tailed)			.001	.028
	N		63	52	56
Method 2	Pearson Correlation			1	.387**
	Sig. (2-tailed)				.005
	N			56	52
Method 3	Pearson Correlation				1
	Sig. (2-tailed)				
	N				59

*. Correlation is significant at the 0.05 level (2-tailed).

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

It was noted that there were significant relationships between all of the scores due to the methods used. This is observed from the p-values which are less than 0.05. Since the correlation coefficients are all positive, it implies that there is a directly proportional relationship between the methods.

To determine whether the relationships between the learning styles and the teaching and assessment methods were significant, chi square tests were performed. The results are presented below.

51

Table 4: Chi square analysis- learning styles vs aural and read/write teaching method

Learning styles vs AR teaching and assessment method	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	231.219[a]	260	.900
Likelihood Ratio	147.269	260	1.000
Linear-by-Linear Association	5.258	1	.022
N of Valid Cases	63		

a. 297 cells (100.0%) have expected count less than 5. The minimum expected count is .02.

Table 5: Chi square analysis- learning styles vs aural and visual teaching method

Learning styles vs AV teaching and assessment method	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	284.761[a]	252	.076
Likelihood Ratio	146.644	252	1.000
Linear-by-Linear Association	.101	1	.750
N of Valid Cases	56		

a. 290 cells (100.0%) have expected count less than 5. The minimum expected count is .02.

Table 6: Chi square analysis - learning styles vs visual, aural and read/write teaching method

Learning styles vs VAR teaching and assessment method	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	306.683[a]	260	.025
Likelihood Ratio	134.097	260	1.000
Linear-by-Linear Association	.516	1	.472
N of Valid Cases	59		

a. 297 cells (100.0%) have expected count less than 5. The minimum expected count is .02.

The chi square null hypothesis states that there is no relationship between learning styles and teaching and assessment methods. Since the p-value for the last relationship is less than 0.05 (the level of significance), it implies that the null hypothesis is rejected and that a significant relationship exists between the students' learning styles and the students' performance in the VAR teaching and assessment method.

Since the same students were tested using methods, paired t-tests were performed to determine significant relationships (in scores). The results are presented in table 7 below.

Table 7: Results of paired t-tests

	Pair 1	Pair 2	Pair 3
A	-	-	-
AK	-	-	-
ARK	.028	.000	.006
K	.234	.027	.020
R	.345	.003	.017
RK	.600	.069	.305
V	.916	.008	.078
VAK	-	-	-
VARK	.118	.000	.000
VK	-	-	-
VRK	.254	.070	.213

Pair 1 =   AR teaching and assessment method * AV teaching and
            assessment method

Pair 2 =   AR teaching and assessment method * VAR teaching and
            assessment method

Pair 3 =   AV teaching and assessment method * VAR teaching and
            assessment method

For the ARK learning style, all methods showed significant relationships. This
implies that this classification type (ARK) shows a relevance to each method
type. Significant relationships existed in pairs two and three for the K, R and
VARK learning styles and the visual learning style only showed a significant
relationship for pair two. None of the other pairings showed any significant
relationships between student learning style and teaching method.

Of the 63 students that attended the aural and read/write teaching and assessment method, 49 students had a learning preference which was a match to the teaching and assessment method being employed and 14 students had learning preference that were a mismatch or did not match the teaching and assessment method being employed. As illustrated in Figure 10. below, 38 (78%) of the 49 students in the matched category, passed the assessment while 11 (22%) of the students in the matched category failed the assessment. Eight (57%) of the students in the mismatched category, passed the assessment while six (43%) of the eight students in the mismatched category failed the assessment.

Of the 56 students that attended the aural and visual teaching and assessment method, 30 students had a learning preference which was a match to the teaching and assessment method being employed and 26 students had learning preference that were a mismatch or did not match the teaching and assessment method being employed. As illustrated in Figure 10. below, 20 (67%) of the 30 students in the matched category, passed the assessment while 10 (33%) of the students in the matched category failed the assessment. 17 (65%) of the 26 students in the mismatched category, passed the assessment while 9 (35%) of the 26 students in the mismatched category failed the assessment.

Of the 59 students that attended the visual, aural and read/write teaching and assessment method, 51 students had a learning preference which was a match to the teaching and assessment method being employed and 8 students had learning preference that were a mismatch or did not match the teaching and assessment method being employed. As illustrated in Figure 10. below, only eight (16%) of the 51 students in the matched category, passed the assessment while 43 (84%) of the students in the matched category failed the assessment. One (13%) of the eight students in the mismatched category, passed the assessment while seven (87%) of the eight students in the mismatched category failed the assessment.
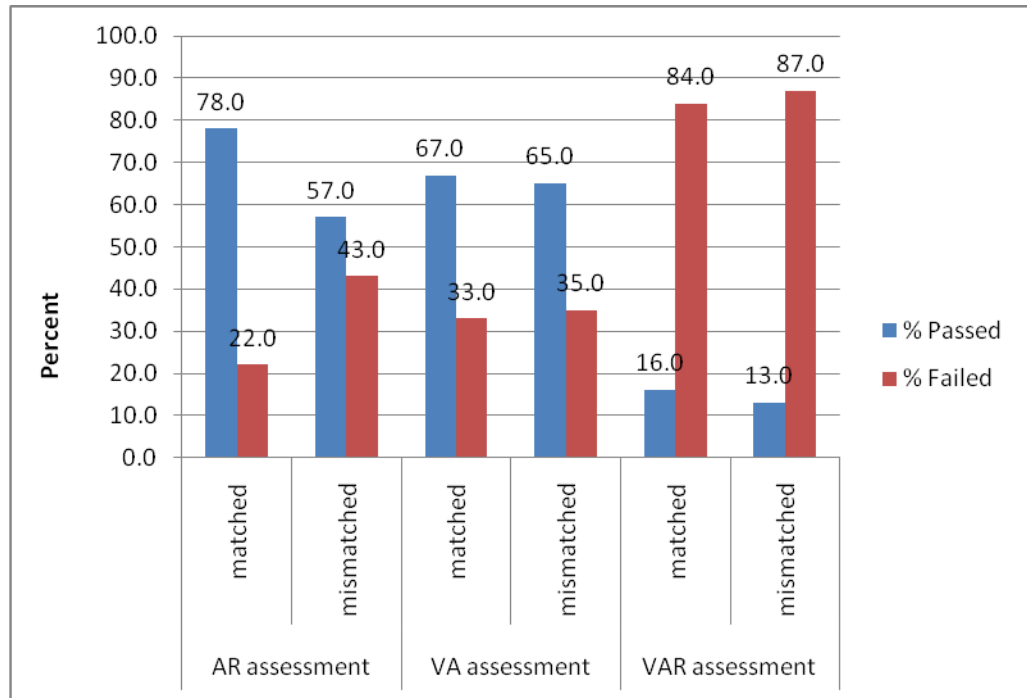
Figure 10: Performance of students in the three assessment methods

Chi Square Tests

The null hypothesis states that there is no relationship between student performance and matching teaching and assessment methods.

The results are presented in the table 8 below.

Table 8: Results of chi square tests

	Calculated Chi Square Value	Critical Chi Square Value
AR Method	2.30179	3.84
VA Method	0.01021	3.84
VAR Method	0.11810	3.84

Since the calculated values were less than the critical chi square value, the null hypothesis was accepted. That is, there is no significant relationship between the performance of the students and the matched teaching and assessment method.

In this chapter, the results obtained during the course of the study were presented and analysed using a variety of statistical tests. The next chapter will contain the discussion of the results and conclusions derived from the research.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

An enduring question for educators and educational research, is the impact of individual student differences on the effectiveness of learning as such differences present a profound challenge to the designers of the teaching and learning environment (McLoughlin, 1999).

The purpose of this study was to explore the learning styles of the first year anatomy students and to assess gender differences in the learning style preferences among the students. To this end the results of the VARK questionnaire will be discussed and any correlations that exist between the results and other studies will be explored. A further aim of the study was to investigate the impact of matching student learning preferences with teaching and assessment on student performance in the course. The student results from the three teaching and assessment methods used will be discussed and conclusions drawn from the findings.

In this chapter, the results presented in chapter four will be discussed The chapter will include the limitations of the study as well as suggested areas of interest for future research.

Discussion

The results of the VARK questionnaire have highlighted the degree of diversity present amongst the first year anatomy students who participated in this study. The majority of the students have a multimodal preference of information transmission. These students prefer information to arrive at them in a variety of

modes and usually require more than one mode to ensure that the information is processed and understood. This result is consistent with studies conducted by Lujan and Dicarlo (2006), Baykan and Nacar (2007), Slater et al (2007), Wehrwein et al (2007), (Alkhasawneh, et al., 2008) and Breckler et al (2009). All the studies mentioned were conducted with students from the health science faculty and using the VARK questionnaire.

Most educational experiences assume that all students in the class process and organize information in the same manner (Arthurs, 2007) with the most commonly used technique being the passive lecture format utilizing the aural mode. It is interesting to note that the results of the current study indicates that only 1 student (1.49%) of the total student population exhibited a unimodal aural preference. This finding is consistent with other studies which found that the aural mode was either the least or second least favoured unimodal (single mode of) preference (Alkhasawneh, et al., 2008; Breckler, et al., 2009; Kumar, et al., 2009). The modes most commonly favoured by the first year anatomy students were the kinaesthetic (42% of students in current study) and read/write (38% of students in current study) modes. This finding was consistent with other studies conducted on health science students (Alkhasawneh, et al., 2008; Breckler, et al., 2009; Kumar, et al., 2009)

This study also found a difference in the manner in which the male and female students prefer their information to be transmitted. 68% of the female participants recorded a multimodal learning preference, while 58% of the male participants were recorded as multimodal learners. These findings differ from the Wehrein et al (2007) study that found that the 87,5% male participants were multimodal as opposed to 45,8% of female participants, and from the Slater et al. (2007) study that found that an equal percentage of male students (56,1%) and female students (56,6%) were multimodal. It must be noted however that the Wehrwein et al study findings were based on 48 respondents who provided gender information and the study did not elaborate as to the number of females

and males that participated in the study. The findings of this study were consistent with the results of the Breckler et al. (2009) study in terms of the ratio of female to male students and which recorded a greater percentage of multimodality exhibited by their female participants (62%) than the male participants (54%). The trend that emerged from the previous studies (Slater et al., 2007 and Breckler et al., 2009) and my study is that females have a greater tendency to multimodal learning preferences than male.

It is apparent from the results presented in chapter four that the students in the first year class exhibit a wide variety of learning styles and hence the lecturer in charge needs to appreciate and attempt to accommodate this diversity in the preparation, delivery and assessment of the anatomy course content. The results of the VARK questionnaire, in addition to highlighting differences that exist in any particular class of students, can be most appropriately used as a catalyst for discussion with the students about their learning processes (Fleming, 1995; Slater, et al., 2007).

McLoughlin (1999) stresses the need to carry out a needs analysis or profile of the current student body so that educators can gain prior knowledge as to the backgrounds, motives, attitudes and learning styles of the students. This information is crucial as McLoughlin (1999) reports that individual student qualities play a role in and somehow influence the students' willingness to gain from the teaching strategies used by the educator which in turn will influence the students' academic performance. However the reality is that in many institutions, due to increasing student numbers and decreasing budget and staffing, the needs analysis is not carried out or the scope of its use is limited and students are left to fit into the already existing system and are expected to cope (McLoughlin, 1999). Also important when designing teaching and learning strategies is the discipline or subject in which the teaching and learning is to occur as different disciplines use combinations of teaching strategies that are exclusive or peculiar to the discipline (Neumann, 2001).

Designing and implementing teaching and assessment strategies that will engage the greater majority of students should remain the aim of all higher education academics. The results of this study highlight the advantages of presenting material in a variety of sensory modes. The bimodal teaching strategies namely aural and read/write and aural and visual yielded assessment results that indicated a greater percentage of students with matched learning styles passed the assessment than those with the mismatched learning styles. It is also of interest to note that 75% of the students included in the mismatched learning styles but who passed the aural and read/write assessment and 71% of the same category of students who passed the aural and visual assessment had a kinaesthetic learning preference either as a unimodality or as part of a multimodal learning preference. Fleming and Mills (1992) suggest and I would agree, that the kinaesthetic mode can be viewed as a multimodality within a unimodality as it is the ability to process information based on hands-on experience and therefore involves the use of all senses to take in information.

Research has suggested that educators should be motivated to move away from their preferred modes to using other modes more suited to the preferences of the students (Wehrwein, et al., 2007). While theoretically this sounds feasible, in practice it is not as easy to implement. My VARK learning profile was kinaesthetic and I prefer to use diagrams and demonstrations to teach areas of the body. Any written material would normally be converted (by me) to a bullet form or flow diagram so that I would be able to better process the information. I also find myself losing concentration very quickly in talks or speeches that have no visual representation and/or case studies. Hence the aural and read/write teaching session was definitely not within my personal comfort zone. I felt uncomfortable during the lecture and had to constantly restrain myself from physically demonstrating a concept or drawing a diagram on the board to highlight events. This uncomfortable (almost desperate, drowning) feeling was further exacerbated by the many students that I could see losing

concentration in what I was presenting and disengaging from the lecture. As a result, I rushed through the information that was being presented which further stressed the students.

Hence it became apparent that even though the aim was to make the student comfortable and accommodate their learning preferences, it is equally important for the lecturer to be comfortable or to be aware of the situations that are uncomfortable for him/her and make a concerted effort to overcome this constraint. None of the research I have consulted actually looked at the teaching and learning process from the view of the lecturer.

The poor results obtained from the aural, visual and read/write teaching and assessment method could be attributed to two factors. Firstly, the manner in which the information was presented to the students. In attempting to subscribe to individual learning preferences, all the information was presented in the written format in the form of a lecture and this was followed by the same information being presented in the visual format using diagrams. The lecture would have been better presented had the written word and the visuals complemented each other and followed immediately. The student therefore gets an explanation of the notes and immediately sees a diagram or visuals of the same work. Separating them as I had done created confusion and anxiety on the part of the students, which could account for the poor assessment scores attained. The second factor could have been the misunderstanding of one of the questions. The question required an description of how the heart gained a blood supply and most students provided a description of how blood entered and left the heart.

A positive learning experience that emerged from this study is that students prefer to have a choice as the method they use in answering test and examination questions. The assessment at the end of each module was based on the sensory modalities as described in VARK. Presentation of answers was the

focus of the assessment, i.e. the student had to present the answer in a paragraph format for the AR assessment method, in the diagrammatic or by means of a flow diagram in the VA method and they had a choice between paragraph, diagram and flow diagram in the VAR method. The responses to these assessment methods forced me to rethink the wording of my questions in tests and examinations.

I used to be quite prescriptive in the question format in the past. For example a question would read: By means of a diagram, illustrate the blood supply of the stomach. It has become apparent that many students are actually restricted by the fact that they have to draw a diagram and even though they know the answer to the question would not be able to put it in the required format. As part of the recommendations of this research study, I would ask lecturers not only to look at the material they are presenting and try and include a variety of ways of expressing this information, but also to look at their methods of testing and to guage whether they are using modes of testing that may restrict the students ability to answer. I have changed all my prescriptive questions to be all inclusive. For example the question of blood supply to the stomach will now read as follows: Briefly describe the blood supply to the stomach. The students will be advised that they may answer the question in the form of a written paragraph, a fully labeled diagram or a flow diagram. The answer remains the same but the student has a choice as to how to present the information.

Hence lecturing is much more than simple presentation of information; it requires a level of creativity on the part of the lecturer. We could liken lecturing to doing a live stage performance, which requires that we know our audience and try to keep them interested by engaging all their senses. However caution must be exercised since (as is evident from my multimodal stint), using multimodality incorrectly can do more harm than good and can leave the student more confused.

While there is no single best way to teach, in order to promote successful student achievement, the methods used must be suitable to the subject being taught while taking into consideration the strengths and weaknesses of all role-players (students and lecturers) (Biggs, 1999; Brown & Atkins, 1988).

My journey as a researcher/lecturer

I began this research project fairly confident about my skills as a lecturer. This confidence was not born out of arrogance but rather derived from feedback that I have received in a formal and informal basis from students and colleagues alike. Therefore it came as a real blow to my senses that there were certain students in my class that sat through an entire lecture and left there without gaining a shred of understanding. As mentioned before, as a person, I have a limited liking for information presentation in the word format and hence my lectures contained elements of the visual, aural and kinaesthetic modes but not too much of the read/write mode. Since embarking on this research, my lecture presentation has not changed drastically because as I have highlighted and as is shown in the literature, a lecturer should be comfortable in the presentation mode as this will minimize confusion. However now I would refer the student to the relevant section in the textbook, where they can access the information in the read/write mode. I have also worked with my students to show them how to reframe information into a format that will be more easily understood i.e. we have practiced making flow diagrams from diagrams and from notes for the students with the visual learning preference. Also we have practiced writing notes about a diagram, or flow diagram for the students with the read/write learning preference.

While we may not be able to change the system of formative and summative assessments employed by the institution, we can aid the students by giving them a choice as to the output mode they use. All the examination questions have been reworded to allow the student the opportunity to answer the

questions in the form that best suit them. I would also like to investigate the possibility in future years, of including the oral testing for those students who prefer the aural mode, either alone or in combination with other modes of learning.

Conclusion

What has emerged from this research is that the students in the class cannot be viewed as tabula rasa as in the past. Each student and lecturer brings something to the class in terms of their preferred way of receiving and disseminating information. The debate about the use of learning styles to direct teaching and learning rages on. However, I believe that using learning styles as a catalyst for creating an all inclusive environment of learning cannot be overlooked.

And while the debate about the advantages and/or disadvantages of matching students' learning styles and teaching style continues, I would agree with Mitchell et al (2009) and Sharp et al (2008), that a balanced environment is ideal. The teaching of Anatomy is ideally suited to this balanced presentation mode as the students can attend a lecture (incorporating notes both verbal and graphic and aural skills) where the concepts and structures are taught and they can then study via specimens, models and dissection (incorporating the kinaesthetic skill) and discussion with their colleagues, thereby creating a varied teaching and learning environment.

The use of learning styles and their very existence are questioned by some researchers (Sharp, et al., 2008). However when dealing with the challenges of an increasingly diverse student body, Pheiffer et al (2005, p. 430) contend that "a learning styles-oriented view offers a positive assessment of learning, positive language and a framework that allows individuals to take control of their learning in an informed manner.

The results obtained in this research provides the first steps of many more to follow, in understanding the link between how students learn and how our teaching and assessment methods affect this learning. Further research is needed to determine whether student learning styles are constant as suggested by some or if they are dynamic and change as the student matures. Research is also needed to investigate whether student learning styles vary between disciplines or remain constant regardless of the discipline being studied. As we attempt to make decisions based on students and how they learn, a qualitative study that presents the voice of the student would be influential in understanding the complexities of how students learn and the impact that particular teaching, learning and assessment environments have on them.

If we are serious about improving the teaching and learning processes at our institution, we cannot overlook the importance of the role of the students in the educational process.

I conclude with the words of Chickering and Gamson (1987, unpaginated)

"There are neither enough carrots nor enough sticks to improve undergraduate education without the commitment and action of students and faculty members. They are the precious resources on whom the improvement of undergraduate education depends."

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Appendix A: Gatekeeper consent form

Department of Basic Medical Sciences
Durban University of Technology
Mansfield Campus
Berea
Durban
4000

complete an online questionnaire to determine his/her learning style and he/she will be subjected to three different teaching and assessment methods to determine how these methods affect his/her performance. This study involves a small component of the curriculum for the year and will not disadvantage the student or compromise his/her year mark in any way.

The results of this study will be used to improve the teaching and learning of anatomy with the intention of enhancing student motivation, retention and improving student pass rates.

My proposal is in the process of being submitted. As part of my ethical clearance application from the University of Kwa Zulu Natal, I need to provide proof that I have obtained permission from my institution to conduct the research with my students. I therefore humbly request permission to conduct this research in the Department of Basic Medical Sciences.

Your assistance in this research will be greatly appreciated. If you have any questions regarding this study, please contact me at DUT – on 031 373 2389 or fazilaa@dut.ac.za . Alternatively, you may contact my supervisor, Mrs. F. O'Brien at 031 260 2291/3086 or obrien@ukzn.ac.za

Your's in education

Fazila Ally

Ph: 082 703 0006 / X 2389

OFFICE OF THE
ACTING DEPUTY VICE-CHANCELLOR: ACADEMIC
PROFESSOR T ANDREW

0 4 MAR 2009

DURBAN
UNIVERSITY of
TECHNOLOGY
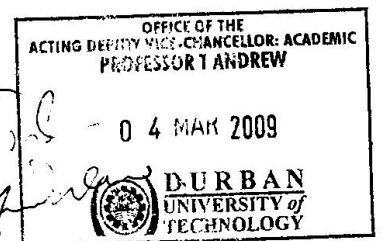
Approved

Appendix B: Permission to use VARK questionnaire

From: Fleming Neil <flemingn@ihug.co.nz>
To: <fazilaa@dut.ac.za>
Date: 1/23/2009 11:18:54 PM
Subject: VARK and Copyright

Dear Fazila

Thank you for seeking permission to use VARK. We rely on the honesty of people to act in a professional way when using our materials. Many don't know that businesses, government agencies and professional sports groups must obtain permission or be licensed to use the VARK copyright materials. You may not place VARK copyright materials on an open-access website, or place the VARK questionnaire on your intranet without contacting us. If you want to use VARK on a site you need special permission.

You are welcome to use the VARK materials by linking to our online website, or in paper format, for your Human Anatomy students, providing suitable acknowledgement is made.

This is the acknowledgement I prefer:
© Copyright Version 7.0 (2006) held by Neil D. Fleming, Christchurch, New Zealand and Charles C. Bonwell, Green Mountain Falls, Colorado 80819 U.S.A.

You may be interested in our new VARK Subscription service which does not need any installation on your system. You can capture the VARK scores for your your class or classes, work team or colleagues and the results are available to you using your own password. The Subscription Service is demonstrated on our website in a working example. There is also sophisticated and specialised VARK software that allows you to capture and use the data from your own students on your own intranet.

To comply with copyright laws, trainers should consider purchasing an inexpensive VARK Licence with a once-only lifetime or annual fee. We also have a VARK PowerPoint presentation, a Resource Kit and a VARK Score sheet for large numbers of respondents.

You may find the two VARK books helpful for your work. There is also a book that teachers use for widening their repertoire of strategies.
It is titled - "55 Strategies for Teaching" and has 55 practical ideas. VARK principles are being applied to coaching athletes and sports players and a new book titled "Sports Coaching and Learning" is now available.

To purchase any of these resources (above) you can use a personal check/cheque, an institutional Purchase Order or buy from our secure website with your credit card.
Best wishes for your work.

Neil
Neil Fleming
Designer of the VARK Questionnaire
50 Idris Road, Christchurch 8052
New Zealand
www.vark-learn.com
phone: (64) 3 3517798
fax: (64) 3 3519939

Appendix C: Ethical approval form

UNIVERSITY OF
KWAZULU-NATAL

RESEARCH OFFICE (GOVAN MBEKI CENTRE)
WESTVILLE CAMPUS
TELEPHONE NO.: 031 – 2603587
EMAIL : ximbap@ukzn.ac.za

30 OCTOBER 2009

MRS. F ALLY (945352924)
ADULT AND HIGHER EDUCATION

Dear Mrs. Ally

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/0780/09M

With reference to my letter dated 23 June 2009. I wish to advise that due to a change in the numbering system for ethical clearance, your ethical clearance number for the project mentioned bellow will now change to **HSS/0780/09M**

> "Linking learning, teaching and assessment styles for Anatomy students at a South African University of Technology"

Yours faithfully

PROF. S COLLINGS (CHAIR)
HUMANITIES & SOCIAL SCIENCES ETHICS COMMITTEE

cc. Supervisor (Mrs. F O'Brien)
cc. Ms. R Govender

g Campuses: ▬ Edgewood   ▬ Howard College   ⠂⠂ Medical School   ▬ Pietermaritzburg   ▬ Westville

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Appendix D: Participant consent form

Dear Student,

My name is Fazila Ally and I am the lecturer for the Anatomy I course which you are currently studying. I have a Medical Science degree with Honours in Anatomy and a Higher Diploma in Education. I am very interested in the teaching and learning of anatomy and I am currently researching an instructional strategy to improve the teaching and learning of anatomy at the Durban University of Technology (DUT) as part of a Masters Degree in Education.

The problem currently facing all higher education institutions in South Africa is one of high student dropout rates (especially in first year) and low graduation rates. The challenge to lecturers in higher education is to recognise potential and facilitate success in the existing student body. In order for us to do this we have to find how our students interact with or process information and to adapt our teaching styles to cater for the differences in the student body so that all students benefit from the teaching and learning experience.

 For the purpose of this study, you will be required to complete a short online questionnaire to determine your learning style, and you will be experience three different teaching and assessment methods to determine how these methods affect your performance. This study involves a small component of the curriculum for the year and will not disadvantage you or compromise your year mark in any way.

The results of this study will be used to improve the teaching and learning of anatomy with the intention of enhancing student motivation, retention and improving student pass rates.

While your identity is necessary for me to track patterns that exist between matched and mismatched learning, teaching and assessment styles, your identity will not be revealed in any discussion or written articles relating to the study.

Your completion of the online questionnaire is voluntary and you may choose to withdraw from the research study at any stage without any repercussions to you. I do hope however, that you will participate as your assistance in this research will serve not only to improve the teaching and

learning of anatomy but will also provide you with study skills (that will be specific to your learning preference as determined by the study) to empower you to succeed as a learner. I will be happy to discuss your results from the questionnaire with you, individually, should you wish to follow this up.

Your assistance in this research will be greatly appreciated. If you have any questions regarding this study, please contact me at DUT – on 031 373 2389 or fazilaa@dut.ac.za . Alternatively, you may contact my supervisor, Mrs. F. O'Brien at 031 260 2291/3086 or obrien@ukzn.ac.za

……………………………………………………………………………

DECLARATION OF PARTICIPATION

I………………………………………………………………………
(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

SIGNATURE OF PARTICIPANT   DATE

_____   _____

Appendix E: VARK questionnaire

English

Version for Younger People - Version for Athletes

Home
FAQ
Questionnaire
Helpsheets
Using VARK
What's new?
More information
Books & software
Contact Us
Site Map
Copyright

busuu.com
the language learning community!

Start learning NOW

interested in books about
Teaching and Learning?
page

The VARK Questionnaire

How Do I Learn Best?

Questionnaire version 7.1 More Information

Choose the answer which best explains your preference and tick the box next to it.
Please tick more than one if a single answer does not match your perception. Leave blank any question that does not apply.

You are not sure whether a word should be spelled 'dependent' or 'dependant'. You would:

☐ think about how each word sounds and choose one.
☐ see the words in your mind and choose by the way they look.
☐ write both words on paper and choose one.
☐ find it in a dictionary.

I like websites that have:

☐ audio channels where I can hear music, radio programs or interviews.
☐ interesting written descriptions, lists and explanations.
☐ interesting design and visual features.
☐ things I can click on, shift or try.

You are helping someone who wants to go to your airport, town centre or railway station. You would:

☐ tell her the directions.
☐ go with her.
☐ write down the directions.
☐ draw, or give her a map.

You want to learn a new program, skill or game on a computer. You would:

☐ follow the diagrams in the book that came with it.
☐ talk with people who know about the program.
☐ use the controls or keyboard.
☐ read the written instructions that came with the program.

Other than price, what would most influence your decision to buy a new non-fiction book?

http://www.vark-learn.com/english/page.asp?p=questionnaire   2010/11/10

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☐ Quickly reading parts of it.
☐ The way it looks is appealing.
☐ A friend talks about it and recommends it.
☐ It has real-life stories, experiences and examples.

You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?

☐ Trying or testing it
☐ Reading the details about its features.
☐ The salesperson telling me about its features.
☐ It is a modern design and looks good.

Remember a time when you learned how to do something new. Try to avoid choosing a physical skill, eg. riding a bike. You learned best by:

☐ written instructions – e.g. a manual or textbook.
☐ watching a demonstration.
☐ listening to somebody explaining it and asking questions.
☐ diagrams and charts - visual clues.

A group of tourists wants to learn about the parks or wildlife reserves in your area. You would:

☐ take them to a park or wildlife reserve and walk with them.
☐ talk about, or arrange a talk for them about parks or wildlife reserves.
☐ show them internet pictures, photographs or picture books.
☐ give them a book or pamphlets about the parks or wildlife reserves.

You are going to choose food at a restaurant or cafe. You would:

☐ choose from the descriptions in the menu.
☐ listen to the waiter or ask friends to recommend choices.
☐ look at what others are eating or look at pictures of each dish.
☐ choose something that you have had there before.

You are planning a holiday for a group. You want some feedback from them about the plan. You would:

☐ use a map or website to show them the places.
☐ describe some of the highlights.
☐ phone, text or email them.
☐ give them a copy of the printed itinerary.

You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:

☐ many examples of good and poor photos and how to improve them.
☐ clear written instructions with lists and bullet points about what to do.
☐ diagrams showing the camera and what each part does.
☐ a chance to ask questions and talk about the camera and its features.

You have a problem with your heart. You would prefer that the doctor:

☐ used a plastic model to show what was wrong.

- [ ] gave you something to read to explain what was wrong.
- [ ] described what was wrong.
- [ ] showed you a diagram of what was wrong.

Do you prefer a teacher or a presenter who uses:

- [ ] handouts, books, or readings.
- [ ] demonstrations, models or practical sessions.
- [ ] question and answer, talk, group discussion, or guest speakers.
- [ ] diagrams, charts or graphs.

You are going to cook something as a special treat for your family. You would:

- [ ] ask friends for suggestions.
- [ ] use a cookbook where you know there is a good recipe.
- [ ] cook something you know without the need for instructions.
- [ ] look through the cookbook for ideas from the pictures.

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

- [ ] using graphs showing what you had achieved.
- [ ] using examples from what you have done.
- [ ] using a written description of your results.
- [ ] from somebody who talks it through with you.

You have to make an important speech at a conference or special occasion. You would:

- [ ] write a few key words and practice saying your speech over and over.
- [ ] gather many examples and stories to make the talk real and practical.
- [ ] write out your speech and learn from reading it over several times.
- [ ] make diagrams or get graphs to help explain things.

⊘clear ⊗ ok

Appendix F: Participant Verification of Results

Name: _____

Age: _____   Gender: _____

I believe / do not believe that the VARK results obtained are a true reflection of my preferred way of learning.

_____   _____

Student signature   Date
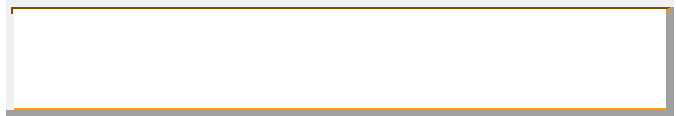

The VARK Questionnaire Results

Your scores were:
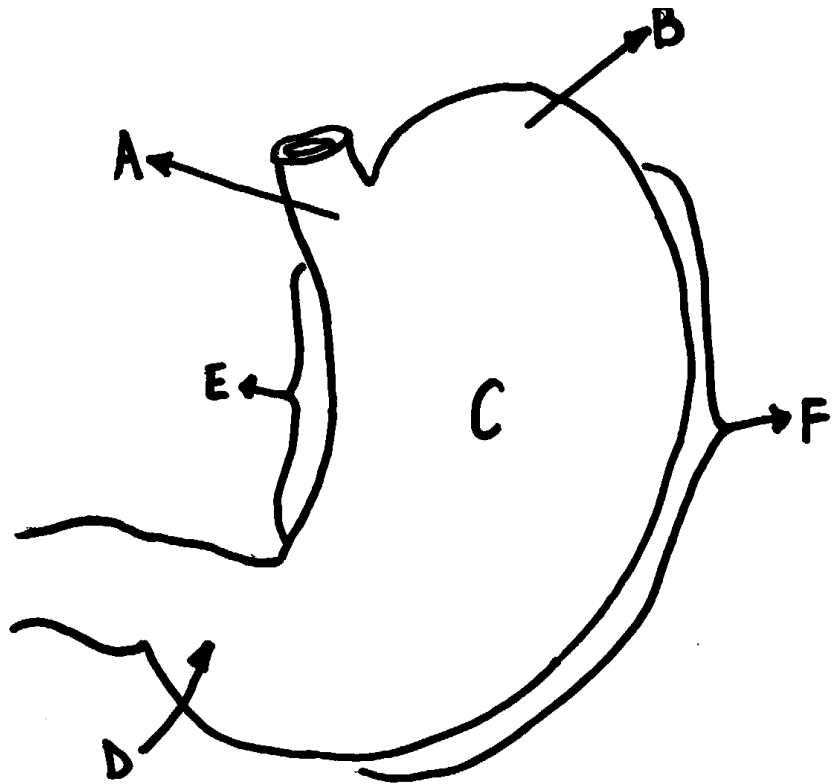
Visual: 3

Aural: 2

Read/Write: 4

Kinesthetic: 7

You have a mild Kinesthetic learning preference.

Use the following helpsheets for study strategies that apply to your learning preference:

Kinesthetic

Appendix G: Stomach diagrams

PARTS OF THE STOMACH AND SURFACE ANATOMY
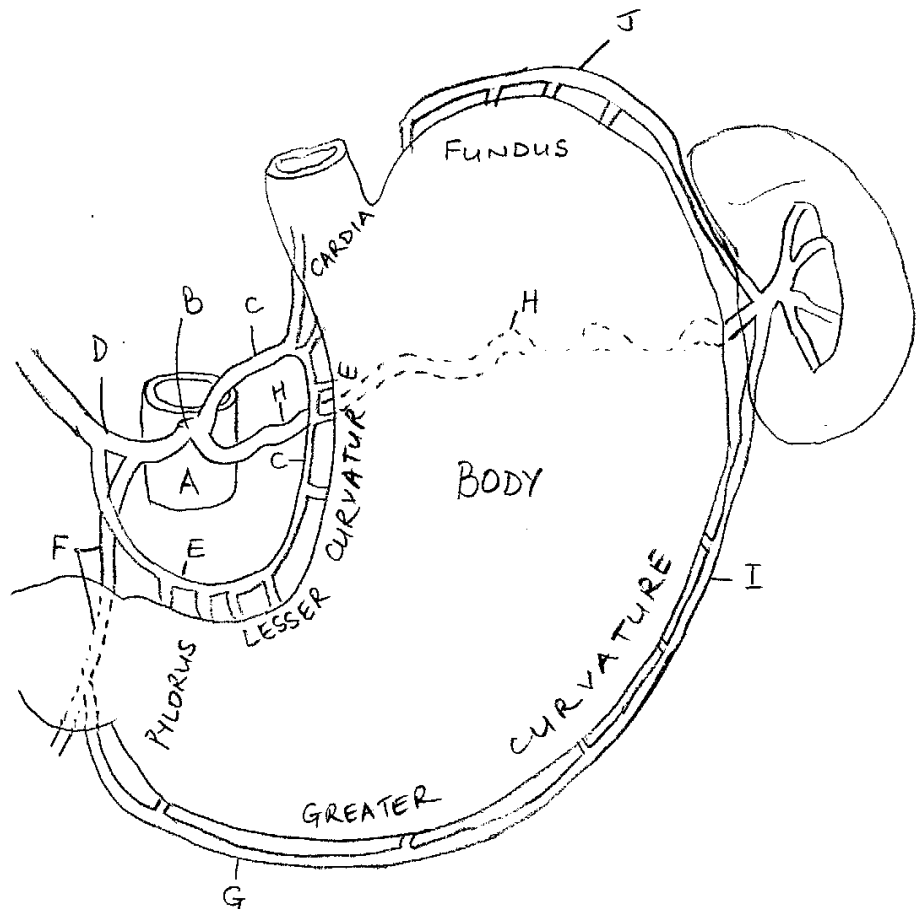

PARTS OF THE STOMACH and SURFACE ANATOMY

A:

B:

C:

D:

E:

F:

BLOOD SUPPLY OF THE STOMACH

ARTERIES OF THE STOMACH

A:_____   F_____

B:_____   G:_____

C:_____   H:_____

D:_____   I:_____

E:_____   J: _____