CHAPTER 2

LITERATURE REVIEW

"The issue today is not whether the country has a sufficient supply of physicians, but whether the physicians that our academic centres produce are congruent with our country's health needs"

Petersdorf (1998:25)

This chapter comprises a review of the relevant literature on the role played by the knowledge gained in the context of teaching and learning Anatomy in contributing to the quality and performance of medical doctors. The above quotation illustrates how the importance of the training of clinicians is evaluated by society. From this, it is clear that there is a need to match the health needs of the society to the medical training of practitioners. It was taking into account this reality that the World Federation for Medical Education project "on international standards in Medical Education,

recommended by the World Health Organization and the World Medical Association has three main intentions: to stimulate medical schools to formulate their own plans for change and for quality improvement in accordance with international recommendations; to establish a system of national and/or international assessment and accreditation of medical schools to assure minimum quality standards for medical school programmes and to safeguard practice in medicine and medical manpower utilization, by well-defined international standards of medical education" (WFME, 2000: 665).

2.1 MEDICAL PRACTICE AND ITS NEED FOR THE BASIC SCIENCES

2.1.1 The need for the basic sciences in general

Undergraduate education in a medical school is the first step in a continuum of professional practice training of the medical doctor. At the completion of this step the faculty of medical schools should ensure that students have acquired skills that enable them to meet the demands of their professional life. As has been reported by several authors (Rolfe & Sanson-Fisher, 2002; Whittle & Murdoch-Eaton, 2002 and Wun, Dickinson & Chan, 2002) medical education is defined worldwide as the process of teaching, learning and training of students with an ongoing integration of knowledge, experience, skills, qualities, responsibility and values which qualify an individual to practice medicine. This process starts during undergraduate education or basic medical education which is the period beginning when a student enters medical school and ends with the final examination for basic medical qualification.

Commonly, the undergraduate medical education comprises a pre-clinical and a clinical period. Recently many medical schools around the world have moved away from the traditional discipline-oriented curriculum towards a more integrated curriculum, particularly in the pre-clinical phase in an attempt, as remarked by Boelen (2002), to follow Flexner who was a strong advocate for the adoption of high standards in the preparation of future physicians, suggesting that physicians should practise medicine with a critical mind, always searching for evidence for the appropriateness of their decisions,

Until the early 20th century, as argued by Beck (2004), medical training, particularly in America, relied primarily on an apprenticeship model of education. The discipline-based teaching became prominent for basic science education following on Flexner's (1910) recommendations and is defined as teaching of the individual classical medical disciplines such as Anatomy, Biochemistry, Pathology, Surgery or Community Medicine as separate educational building blocks while subject-based teaching is a method of teaching in which each subject area of the curriculum is addressed separately. In both cases, it is left to the student to put together the knowledge gained in each discipline to form an overall picture of medicine.

The latter part of the 20th century saw a surge of interest in reforming medical education which can be traced back to Case Western Reserve School of Medicine, which pioneered an organ-system based structure to its curriculum in the late 1950s. According to Morrison (2003) most American medical schools use an organ-system structure in the second year of the medical school curriculum, but maintain a discipline oriented structure in the first year of medical school, though there are

many variations on the theme. Indeed, as stated by Hamilton (2000), interest in changing the organization of medical curricula arose from the assumption that dividing medicine into disciplines is an artificial construct, since the real world of medical practice is trans-disciplinary in large part. Physicians begin their interactions with patients in an open-ended way, even if they are specialists. The internist must consider a surgical or obstetrical or psychiatric cause of abdominal pain when first encountering a patient with that complaint, therefore dividing the basic sciences into disciplines can be seen as an artificial scheme that serves a specific purpose, namely, scientific investigation.

More recently, an integrated teaching approach has been adopted as a method of teaching that interrelates or unifies subjects frequently taught in separate academic courses or departments. As argued by Tavanaiepour, Schwartz & Loten (2002), in this model subjects are presented together as a meaningful whole. The integration can be vertical or horizontal, or both. Horizontal integration functions between parallel disciplines such as Anatomy, Histology, Biochemistry or Medicine, Surgery and Pharmacology.

Vertical integration functions between disciplines traditionally taught in different phases of the curriculum; it can occur throughout the curriculum with medical and basic sciences beginning together in the early years. However, as stated by authors such as Harden, Davis & Crosby (1997) and Lam *et al.* (2002), organ-based teaching, an approach in which medical competence is gained by focusing on one organ system at a time and that integrates different disciplines (subjects) such as Biochemistry, Physiology and Anatomy, has ultimately led to the more common problem-based

approach where knowledge and skills unfold as elements in cases that illustrate real life situations.

In an attempt to make the teaching of basic science content more relevant to clinical practice, medical schools should ensure that the sciences of medical practice be integrated throughout the entire course of study. However, according to Hyppola, *et al.* (2002), the medical curriculum in most universities, is still divided into preclinical and clinical phases, without much communication between the two. This can still lead to a situation where knowledge of the preclinical disciplines has little relevance to clinical subjects and, at worst, clinical studies have little relevance to practical needs. Barrows (1991) noted that, in general, most traditional curricula consist of many separate and poorly interconnected disciplines, giving students the impression that the basic sciences were merely a hurdle to be tackled in the early years of Medical School, although they are in fact necessary to form a firm foundation of knowledge that is vital if the doctor is to maximize their diagnostic and therapeutic skills.

This view supports the findings of Patel, Groen & Scott (1988) about the inconsistent use of basic science knowledge by clinical students, and is also compatible with Issenberg & McGaghie (2002) who suggested that the learning of basic science and clinical work take place more or less independently of each other, at least when taught in a traditional curriculum. Similarly, Noguchi *et al.* (2002) have argued that during the evaluation of a patient, medical doctors often fail to understand the importance of negative information due to the fact that teachers or textbooks often emphasise information on abnormal findings, but there is less emphasis on the significance of normal findings ruling out disease.

One explanation for this tendency may be related to the organisation of the traditional medical curriculum, i.e. focusing on acquiring basic science/medical knowledge without relevant linking to the clinical applications. On the other hand, authors such as Lam *et al.,* (2002) and Guldbrand *et al*., (2003) have reported that in their studies related to the early introduction of clinical skills, medical students in the clinical years, were very concerned when they found themselves unable to understand the clinical sessions and they attributed this to the lack of a strong foundation in basic sciences at that point of their training.

In addition, as Hines (1979) had argued, a greater personal knowledge of the basic medical sciences other than Anatomy may result in a more frequent application of those subjects, such as a greater use of laboratory investigations in consequence of greater biochemical knowledge. Effectively, for example, studies on medical reasoning (Patel & Dauphinee, 1984 and Patel, Groen & Scott, 1988) have shown that although students' use of basic science knowledge, including anatomical knowledge, will depend on the effectiveness of their medical training, in general, recall of important basic science concepts is relatively poor while certain too detailed aspects of the basic science information could be recalled accurately. Thus, as Patel, Groen and Scott (1988) argued, it is reasonable to assume that students' use of basic science knowledge will depend on the level of medical training.

According to Rashid *et al.* (1994), arguments such as these stress the need to strengthen the training of medical doctors. More particularly, the ability to apply the basic sciences in the clinical context firstly requires a horizontal integration of the pre-clinical disciplines (Anatomy, Histology, Physiology, Biochemistry, Microbiology, etc.), which

should be seen as a necessary prerequisite for integration of the pre-clinical disciplines with the clinical ones (Surgery, Internal Medicine, Neurology, Infectious Diseases, etc.).

2.1.2 The need for Anatomy and its role in medical training

Medicine is a profession that requires a large number of capacities, knowledge and skills and among those, as stated by Barrows (1991); Charlton (1991); Esperança-Pina *et al*. (1992); Monkhouse (1992) and Pinto-Machado (1996), the skills and knowledge gained in the context of teaching and learning Anatomy play a fundamental role in contributing to the quality and performance of doctors. Hence all doctors need to know the basis of Anatomy in order to identify the clinical problems, arrange the appropriate investigations for their patients and to interpret the results. It was in this context that Balla *et al.* (1990) have described how the so-called basic sciences, including Anatomy, have constituted a fundamental part of the medical curriculum in all western medical schools since Flexner's recommendations were adopted.

Effectively Anatomy, as defined by many authors (e.g. O'Rahilly, 1985; Eizenberg, 1988; Latarjet & Liard, 1996 and Rouviére & Delmas, 1996) is the study of the structure of the human body, involving the description of form and the explanation of how a structure develops. It is expected that the study of Anatomy should provide the students with the opportunity to gain an organised, basic understanding of the subject which will help equip them with the foundation for more advanced anatomical and medical studies throughout a career in medicine. It constitutes an integral part of the training of medical students world-wide and remains one of the most extensive and

demanding basic science disciplines due to its immense knowledge base and diversity of components (Pinto-Machado, 1991).

Allen & Roberts (2002) reinforced the importance of the role of Anatomy in medical training when they suggested that a curricular priority at medical schools should be to integrate the basic sciences more closely with clinical medicine. The knowledge of Anatomy, which is essential particularly for doctors' understanding of radiographic imaging and their clinical proficiency, provides an ideal test case for meeting this objective.

2.2 UNDERGRADUATE MEDICAL EDUCATION: SELECTING AND PRESENTING CONTENT

2.2.1 General considerations

Traditionally, doctors have been regarded as competent enough to start working with patients immediately after their graduation. These responsibilities, as argued by authors such as Cox (1987) and Rashid *et al.* (1994) have underlined the need to strengthen the training of general practitioners, since the principal purpose of a medical school is to produce doctors, that is, competent professionals. Consequently, as argued by Cox (1987), teaching in medical school, should be designed to provide usable knowledge and skills that the student can apply to health problems

Furthermore, various researchers (Hill, *et al*., 1998; Cantillon & Jones, 1999; Hyppola,

et al., 2002 and Wun, Dickinson & Chan, 2002) have claimed that it is well recognized that the boundaries of subject matter for producing competent doctors can be defined by the illnesses of the individuals and groups that the doctor will be likely to face, and by the doctor's responsibilities within the care of those illnesses. Undoubtedly, such subject matter includes all the relevant underlying knowledge of basic sciences necessary to understand those illnesses and their management and involves much more besides the diagnosis and treatment of patients' diseases.

In general, as stated by O'Neil, Metcalfe & David (1999) the study of pre-medical disciplines comprises an introduction to the physical, chemical and biological basis of life, whereas in basic medical courses such as Anatomy and Histology students acquire knowledge and understanding of the structure and function of the human body. The pre-clinical courses such as Immunology, Microbiology, Virology, Parasitology, Pharmacology, Anatomical Pathology, Histopathology and Pathophysiology provide an understanding of disease mechanisms, their effects and causes, and drug actions.

The clinical courses such as Paediatrics, Surgery and Obstetrics are usually focused on various diseases, the methods of their detection (diagnosing), prevention and therapy. Relevant public health courses are matters concerning environmental and social health factors together with the doctor's role in the prevention and treatment of disease. In addition, it is common for students to gain insight into Ethics, Elementary Research Methods, Statistics, Medical Informatics and Medical Terminology with an introduction to Medical Literature, sometimes including foreign languages.

In the past, as claimed by Vernon & Blake (1993) the clinical content of undergraduate medical courses has been largely determined by tradition or the views of certain influential individuals or disciplines and in many of them individual subspecialties could define what students needed to learn, often without reference to the cases the students will need to be competent in by the time of graduation. These endeavours have resulted in excessive overloading of the curriculum and consequently the dependence upon sheer memory which tends to impact negatively on the process of learning up to the point where students will try to learn too much, and the teachers will try to teach them too much, neither perhaps, with great success (Bordage, 1987 and Worley, March & Worley, 2000).

As Noguchi *et al*. (2002) have claimed, efforts to provide instruction in too many subjects in too great detail led to the position that the traditional undergraduate curriculum is recognised as being grossly overcrowded with factual information, some of which is likely to be out of date before the students even begins to practise. In this situation students have been obliged to memorise too many details too early, often before they have become oriented in the work.

According to Charlton (1991), this is partly a result of the extremely broad coverage of basic science subjects, and partly the result of the teaching methods used (textbooks, lectures and demonstrations/practicals), since in the medical course the students are taught about science instead of how to do science and taught scientific knowledge instead of the methods and skills of science. Thus, it is usual to see students attaching importance to the details instead of developing abilities to use the most necessary knowledge in the context of their medical practice. Students should

be required to master the more general concepts of the arts and sciences relevant to the practice of medicine and the processes through which this conceptual material is used to solve medical problems, (Charlton, 1991).

To this end, as argued by Towle (1993), a medical curriculum should emphasise the understanding and application of concepts, concentrating on the principles of medicine and the application of the scientific approach to clinical problems. The principles of problem solving, constructing a differential diagnosis, planning investigations and management of the patient should be covered, including an analysis of how decisions are made, the process of problem solving and the difficulties and uncertainties of medicine. Then, the main skills that need to be taught to undergraduate medical students are skills of diagnosis (including history taking through the interview, physical examination, a few basic diagnostic tests), basic principles of patient management (especially the principles of first aid, resuscitation and acute care), communication skills, interpersonal skills and managing one's own time and further learning (Towle, 1993).

According to Issenberg & McGaghie (2002), although there is a growing trend to introduce clinical skills training earlier in the curriculum and there is evidence of a growing movement towards international standardisation of medical curricula, institutions that have integrated clinical skills training into their existing curricula undergo similar growing pains that include:

- lack of correlation with basic sciences
- increase in student work that results from adding training sessions without removing previous didactic sessions

- misunderstood purpose of the OSCE by students and/or faculty who focus on the summative assessment rather than formative feedback
- lack of sufficient time for students to practice and perfect skills
- faculty who are either unenthusiastic or ill-prepared to serve as skills instructors
- lack of defined learning outcomes for both students and faculty.

2.2.2 The Anatomy content in the curriculum

Despite the fact that it is important for students to develop the ability to solve practical, real-life problems related to the knowledge they have acquired, the acquisition of basic anatomical facts is still essential to the training of medical doctors (Pinto-Machado, 1991). Thus, core course anatomy should be taught in a way which promotes an understanding of what is experienced in clinical practice. This supports Wells (1964), who, in referring to the teaching of anatomy many years ago, stated that teachers are being asked to teach the student not what he is going to require to know to get through his examinations, but what his clinical teachers are going to require him to know through the rest of his course and what he will be required to know for the rest of his medical career. The same opinion was reported in the study of Gustavson (1988) where, for example, a student said: “it is as if the anatomy class was a ticket to the rest of the training to become a physician.”

Undoubtedly, understanding Anatomy is essential to understanding other subjects in the medical curriculum. In the traditional curriculum Anatomy is taught methodically, where Basic Anatomy is taught first, followed by the various regions of the body. The

related Histology and Embryology are usually taught together. As stated by McKeown *et al*. (2003), this approach provides a holistic approach with a good understanding of the regions of the body and the mutual relationship of the organs and systems. However, as claimed by Eizenberg (1988) the study of human Anatomy may be attempted in either of two ways. One consists of collecting facts, and memorising them and the other consists of correlating the facts, that is, studying them as regards their mutual relationships. It means that traditionally, the teaching of anatomy has adopted either a systemic or a regional approach.

Several authors (Ellis, 2002; McCuskey, Carmichael & Kirch, 2005 and Fasel, Morel & Gailloud, 2005) argue that if it is accepted that Anatomy is the language of medicine, then it should be accepted that all students should have a good understanding of Anatomy at an early stage of their training. Although there are people disputing the value at undergraduate level of learning the origin and insertion of every muscle and the intimate, protracted course of every nerve, if it is borne in mind that not everyone aspires to be a surgeon or radiologist, it is important to consider carefully at what level undergraduate Anatomy should be pitched. For Hines (1979), assuming that it will be impossible for any student to learn all that is known, Anatomy should be taught by means of a short introductory course of about one year, followed by detailed regional anatomy integrated with the relevant clinical courses. For instance, the student in the orthopaedic department could receive instruction on the structure and function of bones and joints at the same time as studying the diseases and injuries of those parts.

As stated by Allen *et al.* (1993), although the amount of Anatomy teaching had been cut from "several hundred" hours, many efforts have been made in recent years to make

Anatomy courses more expansive in an effort to integrate basic structure with various imaging modalities and clinical correlates. An increasing number of techniques are being established whereby the internal structure of the body can be assessed during life without surgical intervention. Effectively, Anatomy is being taught in a more sophisticated way, using electronic models, images such as X-rays and Magnetic Resonance Image's but it leads to the point where students are faced with managing larger volumes of learning resources that come from widely dispersed sources and in a variety of different formats.

Many of the attempts to adjust the role of Anatomy in the training of medical professionals have changed much of the Anatomy that was of purely theoretical interest in the past to that which is of practical importance now. As a consequence of this role, a confluence of forces seems to be changing the way medical education approaches the content of gross Anatomy, which is now devoted almost entirely to preparing students for clinical practice, rather than existing as a distinct field of science in its own right, (Dyer and Thorndike, 2000).

However, authors such as Goodard & Fares (1997) have expressed dissatisfaction with the current trends towards reducing Anatomy content, arguing that the core knowledge gained from the undergraduate Anatomy curriculum is insufficient to guide the orthopaedic trainee through the multitude of surgical approaches that he/she may require. A similar point of view was presented by Heylings (2002) who claimed that anatomists and surgeons involved in the higher surgical examinations have seriously commented on candidates' lack of understanding and knowledge of Anatomy.

2.3 UNDERGRADUATE MEDICAL CURRICULUM: METHODS OF TEACHING-LEARNING

2.3.1 General considerations

The process of teaching in medicine requires versatility, since according to Kelliher (1996) teachers face a variety of challenges influenced by differences in learners, variation in content to be taught, and differences across learning settings. Each of these variables prompts a teacher to come up with new ways to enhance the effectiveness of their teaching approach. Over the past few years, a wide range of different teaching and learning methods have been introduced and tested, often with the aim of developing skills which more didactic methods are poorly adapted to do.

Several studies (Powell, 1988; Alfayez, Strand & Carline, 1990 and Tavares, Silva & Pinto-Machado, 1991) have showed that there are other factors influencing the learning process of medical students such as prior knowledge, interests, attitudes and aspirations which students bring into the classroom, in addition to the subject matter, teaching methods, learning tasks, assessment procedures, teachers and departmental environments which they encounter in the University.

Holcomb & Garner (1973) believe that, as in other areas of education, the processes by which medical students learn have important implications for teaching and learning in the medical curriculum since the instruction will be effective if students learn as a result of it, and specific teaching methods are of interest to medical students only to the extent that these methods lead them toward their goal of becoming a physician. This

position is supported by Liddell *et al.* (2002) who stated that medical students perceive themselves to be more competent when they have the opportunity to practice their skills.

In this regard, Cox & Ewan (1982); Pinto-Machado (1991) and Craig & Bandaranayake (1993) argued that it must be taken into account that only methods that promote active learning and bridge the gap between theory and practice can foster student learning, since students understand and remember better if they can fit their learning into a framework. They will be motivated to learn if that framework fits into what they understand as the ultimate goal of clinical practice. It is however important to appreciate that students and teachers often have very different views of the context in which learning takes place and these differences frequently result in outcomes that satisfy neither group of participants (Nnodim, 1988; Powell, 1988 and Crosby, 1996).

According to Kaufman (2003) there seven principles that should guide teaching practice:

- The learner should be an active contributor to the educational process
- Learning should closely relate to understanding and solving real life problems
- Learners' current knowledge and experience are critical in new learning situations and need to be taken into account
- Learners should be given the opportunity and support to use self direction in their learning
- Learners should be given opportunities and support for practice, accompanied by self assessment and constructive feedback from teachers and peers

- Learners should be given opportunities to reflect on their practice; this involves analyzing and assessing their own performance and developing new perspectives and options
- Use of role models by medical educators has a major impact on learners. As people often teach the way they were taught medical educators should model these educational principles with their students and junior doctors. This will help the next generation of teachers and learners to become more effective and should lead to better care for patients

All of these considerations underline the fact that it is necessary to define the roles that a medical teacher is likely to assume, and to specify the abilities that define each role. Such thinking has led to a change in approach to the training of doctors, with a much greater emphasis on students learning to take responsibility for their own acquisition of knowledge and skills. This in turn has encouraged the design of new courses with a substantial element of self-directed learning incorporated into them, with a concomitant decrease in traditional forms of medical education (Barrows, 1991 and Whittle & Murdoch-Eaton, 2002) The traditional approach represents a more teacher-based didactic style of teaching which was used extensively in the preclinical years in particular, where medical students were exposed to endless series of lectures in individual subjects given by teachers determined to cover the content of their subjects completely, often with little regard for its relevance to clinical practice.

Teacher-centred education is an educational system in which the teacher dictates what is being taught and how it is to be learned. The teacher is the central or key figure and activities such as the formal lecture and the formal laboratory practical are emphasised.

Individual students have little control over what they learn, the order in which they learn and the methods they must use to learn. In this approach, learning is said to be rather more passive than active. It is the opposite of the learner-centred approach which may be defined as a method of teaching in which the students' needs have priority and learners are responsible for identifying knowledge gaps, actively participating in filling them, and keeping track of their learning gains. Teachers are expected to facilitate this process instead of supplying "spoon-fed" information. This approach increases the students' motivation to learn and prepares them for self-directed learning and continuous education. According to Wun, Dickinson & Chan (2002), a self-directed learning approach was adopted by medical schools in many countries over the last several decades in an attempt to match the changing healthcare needs of the population with undergraduate medical education.

Most medical schools still have similar configurations. Generally the first two years are classroom-based, with patient contact beginning in the second year. The third and fourth years consist of rotations through the different major specialties of medicine. However, as argued by Clawson (1990), methods of presenting subjects in both preclinical sciences and clinical departments are often unsatisfactory. For Cantillon & Jones (1999), who reviewed the educational methodologies that have been shown to work, the most effective teaching-learning methods include learning linked to clinical practice, interactive educational meetings, outreach events, and strategies that involve multiple educational interventions. The least effective methods are also those most commonly used in teaching i.e. lecture format teaching and unsolicited printed material (including clinical guidelines).

Lecturing or large group teaching, as argued by Butler (1992), is one of the oldest forms of teaching which has historically been quite prominent in education because it is an economical way to communicate information to large groups. Whatever their reputation, lectures are an efficient means of presenting knowledge and concepts to large groups. They can be used to stimulate interest, explain concepts, provide core knowledge, and direct student learning. However, several authors (Cox, 1987; Crosby, 1996 and Coulehan & Williams, 2001) have pointed out that they should not be regarded as an effective way of teaching skills, changing attitudes, or encouraging higher order thinking. Large group formats tend to encourage passive learning. For the same authors (Cox, 1987; Crosby, 1996 and Coulehan & Williams, 2001), students receive information but have little opportunity to process or critically appraise the new knowledge offered.

However, as stated by Kolars *et al.* (1997) increasing knowledge about the group's difficulties in maintaining concentration and absorbing extensive information while in a passive listening mode has brought the value of lectures under criticism and, as far as the teaching is concerned, the focus has shifted from lectures to other more interactive forms of teaching such as practicals, seminars, demonstrations, consultations and clinical audits, where students gain experience in clinical settings, as well as at the facilities of local health centres.

For science subjects, laboratory work is an essential ingredient of the course and some component of this is generally preserved, even though the amount may have been reduced. In addition to the experience of laboratory work, students often derive

a lot of their contact with staff in the laboratory setting, and compensation for this may be needed if laboratory time is significantly reduced.

Other methods that may be considered are numerous, including workbooks, diaries, and laboratory notebooks; computer-based methods; fieldwork; learning in hospital wards and clinics; independent learning tasks; essays, dissertations and projects; library searches; portfolios; posters; videos. There is a substantial literature on these methods and on how best to use them and it is important to take into account that learning to become a physician is different from becoming a research scientist. Medical students need to fit things together as well as take things apart. They need to learn the relationship between the parts, how to synthesise, how to see the big picture. Learning facts is easier when those facts are learned in a relevant and meaningful context. This premise led to the development of problem-based learning (PBL), first at McMaster University, Canada then spreading throughout the world to many other medical schools (Albano *et al*., 1996). PBL enables students to develop the ability to translate knowledge into practice at an early stage, encourages individual participation in learning and also allows the development of teamwork skills. Students in PBL courses have been found to place more emphasis on "meaning" (understanding) than "reproduction" (memorisation). Students must engage in a significant amount of self-directed learning; lectures are kept to a minimum.

From its origins at McMaster University, and followed shortly by Maastricht University in the Netherlands, the PBL model adopted in other medical schools has been adjusted to suit local circumstances. It does however require a heavy investment

in resources (library books, IT, tutorial rooms) as well as requiring training and participation of tutors/small group facilitators.

Whilst there is some evidence that graduates from problem-based curricula feel prepared for clinical practice, there is little comparative data available for graduates from more conventional curricula. Reviewers who have examined PBL research have reached contradictory conclusions. Several studies (Towle, 1993 and Tavanaiepour, Schwartz & Loten, 2002) concluded that students from conventional curricula are better prepared in terms of basic science, since one area in which the problem-based curriculum was perceived to be inferior to the old one was students' factual knowledge of basic sciences. This was in contradiction with the results of the study of Hill *et al.* (1998) which showed no difference in this domain between two graduate groups, one in a curriculum structured in problem-based learning and the other in a traditional curriculum.

However, Berkson (1993) found that "the graduate of PBL is not distinguishable from his or her traditional counterpart"; this conclusion is consistent with a number of studies (Farquhar, Haf & Kotabe, 1986; Kaufman & Mann, 1988; Chang, *et al*., 1995; Albano *et al*., 1996; Login *et al*., 1997 and Blake, Hosokawa, & Riley, 2000) have shown no statistically significant difference in learner performance compared to students receiving lecture-based instruction.

2.3.2 Teaching-learning of Anatomy

Anatomy is essentially the basic language of medicine, the frame for communicating and in many medical schools it is still the course that takes most preclinical lecture hours (Bax & Godfrey, 1997 and Barzansky & Etzel, 2001). On the other hand, human Anatomy laboratory instruction can employ many different types of specimens, models, software programs, and web sites to help students learn the material.

Nevertheless, despite recent technical and electronic innovations for teaching Anatomy, anatomical dissection has been remarkably persistent as a feature of medical education - indeed it stands out as the most universal and universally recognisable step in becoming doctor (Dyer and Thorndike, 2000 and Rodrigues, 2000). No doubt, much of the explanation for this persistence is that performing dissection is still regarded by many as an excellent way to learn Anatomy and one which remains central to the practice of medicine. However, dissection is also a multi-model experience, involving unique smells, sounds, and textures as well as intellectual content. Thus, although the information content of the Anatomy laboratory could perhaps come from elsewhere, its social and psychological value can derive only from the experience of dissection.

In addition, dissection is only a means to the end of a fuller understanding of function. Knowledge of the movements at joints, the muscles that move them and the nerves that supply these structures is essential if the effects of injury or disease are to be understood and rational corrective measures undertaken. According to Romanes (1998) it is unfortunate that the study of Anatomy has to be carried out on the dead, preserved body

in which the texture and appearance of the organs of the body have been altered. However, the purpose of this practice is to allow the students to visualise the living body in action so that the student can appreciate the effects of injury or disease, and can recognise an abnormality from knowledge of the normal. Furthermore, to achieve this kind of information there is no substitute for the personal process of looking at the body by dissection while thinking of the functions of its various parts and checking these points by observation and palpation of the living body (Romanes, 1998).

In 1988 Nnodim reported that in general, students in British medical schools have suggested that fewer lectures should be given in the pre-clinical Anatomy course. In contrast, in Nigerian medical schools this mode of instruction still occupies a spacious niche in the pre-clinical curriculum and students ascribe a high educational value to it. It can be explained by the fact that, as Das, El-Sabban & Bener (1996) suggested, the didactic lecture works very well when there is a limited amount of information to be acquired and it is well presented, but difficulties arise when course content becomes excessive, student numbers are large, or when time constraints exist, which is often the position of the Anatomy course today in many medical schools around the world.

In an interesting series of studies, Nnodim (1990, 1997) and Nnodim; Ohnaka & Osuji (1996) compared prosection study to dissection as methods for teaching anatomy, and followed up with studies on retention of learned material five years after the students took the course. These students were tested using a practical, an oral, and a written format, and the performance of both groups was equivalent overall, with the caveat that the non-dissecting students were somewhat superior in their recall as determined by some qualitative considerations.

In contrast, in the study of Metcalfe and Matharu (1995) it was found that lectures, practicals and bed-side teaching generated more bad reports from students than good ones, while other forms of teaching (seminars and tutorials) were likely to be used as examples of good teaching. Indeed, Lam *et al.* (2002) reported that students found it easier to remember what they had been taught in the practical skills sessions (e.g. surface Anatomy) than that in the lectures, since the practical experience was further enriched when exposed to the real clinical setting during the clinical rotations.

These results support the study carried out by Das, Towsend & Hasan (1998) in which it was reported that a majority of students viewed clinical skills training as a useful experience for learning to detect deviation from normality and for consolidation of theoretical knowledge gained in the early years of the medical training. Similar findings have been described by Guldbrand *et al.* (2003) who reported that learning clinical skills in the early years lessened pressure on the students in their clinical years and it was very clear that students enjoyed the clinical skills sessions a great deal.

Albanese & Mitchell (1993) concluded that in a problem-based curriculum, teaching/learning anatomy suffers just like the other subjects of basic sciences since it is less effective in teaching basic science content, while Vernon & Blake (1993) reported that regarding the basic sciences, PBL approaches were more effective in generating student interest, sustaining motivation, and preparing students for the clinical interactions with patients. For authors such as McKeown *et al.* (2003) and Beck (2004) the PBL curriculum has several advantages over the conventional curriculum but it is important to keep in mind that many important issues in Anatomy related to basic knowledge cannot be taught through clinical problems alone. Such

areas have to be taught through lectures and a hybrid approach to learning Anatomy is recommended in a problem based curriculum.

2.4 EVALUATING THE OUTCOME OF TEACHING-LEARNING IN MEDICAL CURRICULA

2.4.1 Measuring the outcome

The award of the degree is a passport to start working and as such it is vital that students will have demonstrated, comprehensively and repeatedly in the course of their education, that they can achieve sufficiently high standards in terms of skills, knowledge, attitudes and behaviours to be 'good enough doctors'.

Medical education has moved from traditional lectures towards experienced-based methods; from teacher centred to learner centred strategies; from rigid curricula towards a flexible one with core and electives and; from a focus on knowledge, to performance and outcomes (Harden, Davis & Crosby, 1997).

Assessment in medicine as argued by Challis (1999) is also changing. Recognition is increasing that planning assessment needs to focus on assessment programmes or systems rather than individual tools, and that programmes need to focus on several methods and sampling strategies to ensure that the full range of relevant competencies are evaluated as robustly as possible.

Assessment has both formative and summative purposes. In its formative role it is an essential part of the teaching and learning process because it helps students and teachers to identify strengths, weaknesses, and ways to improve since in the testing is part of the developmental or ongoing teaching/learning process In its summative form it provides information which is used to judge the extent to which required aspects of graduate qualities are achieved within a course or program since it is the testing which usually occurs at the end of a term or course and is used primarily to provide information about how much the student has learned and how well the course was taught. Assessment practices should provide meaningful feedback to students. Such feedback should be given in time for students to benefit in preparing for future tasks and constructed to help students gain a sense of progress and to learn from their work (Ebel & Frisbie, 1991).

Assessment should effectively provide an ongoing and dependable method of evaluating students and is the principal means medical schools have to ensure the fitness to practice of their graduates and to provide the necessary evidence of this to the relevant bodies, including the general population of patients (Miller, 1990). An assessment system may be norm-referenced, which is an assessment in which individual student performance is compared to the larger group (Newble & Jaeger, 1983). Usually the larger group or "norm group" is a national sample representing a wide and diverse cross-section of students. The purpose is usually to rank students and not to measure achievement of some criterion of performance, which is the purpose of the alternative criterion-reference assessment system. In the latter an individual's performance is compared to a specific learning objective; tells how a student is performing on a specific goal or standard, rather than how their performance compares to a norm

In practice, however, a combination may be used since the purpose of assessment in an educational context, as explained by Shumway & Harden (2003), is to make a judgment about the level of skills or knowledge, to measure improvement over time, to evaluate strengths and weaknesses, to rank students for selection or exclusion, or to motivate them to learn. Assessment should be as objective and reproducible as possible. A reliable test should produce the same or similar scores on two or more occasions or if given by two or more assessors. The validity of a test is determined by the extent to which it measures whatever it sets out to measure. The selection of assessment items should thus take into account the purpose of the assessment as well as the need for validity and reliability.

According to authors such as Schuwirth & van der Vleuten (2003) examples of specific forms of assessment include Multiple Choice Questions (MCQs); Short Answer Questions (SAQs); Long answer or essay questions; Case or problem based learning scenarios; Simulated patient scenarios; Objective structured clinical examinations (OSCEs); Case presentation; Portfolios; Orals/vivas; Data analysis/interpretation; Objective structured long examinations records (OSLER); Modified Essay questions (MEQ); Log books and Patient management problems (PMP). Each of these will have advantages and disadvantages and will be more suitable for testing certain domains of knowledge and skill than others. Increasing the variety of assessment types is thus more likely to improve the validity of the assessment overall.

According to Blake *et al*. (1996) there is no one ideal means of assessment but it is necessary to ensure that standards in medical education are maintained. In most

medical courses although diversity in both curriculum delivery and assessment itself are encouraged, it is stressed that there is a need to

- define the most appropriate learning outcomes for the curriculum and the best form of assessment for each
- create a correct balance between too much and not enough assessment
- determine the optimal time between curriculum delivery and its assessment
- establish the correct balance between time spent on core curriculum and that spent on the exploration and pursuit of areas of personal interest

In this context a learning outcome should be defined as a statement of that which a learner is expected to be able to do or know at the end of his/her study. In other words, it is statement of the knowledge, understanding and skills which students will acquire during the course. Blake *et al*. (1996) have stressed that although thought processes had been recognized as complex, there was no uniformly accepted way of describing this complexity prior to the taxonomy of Bloom (1956) which allowed classification of thought processes into six dynamic levels.

These levels increase in complexity, from knowledge as the baseline level, through comprehension, application, analysis and synthesis to evaluation as the highest level. This classification is referred to as the "Cognitive Domain of Bloom's Taxonomy of Educational Objectives". There are other domains, “Affective” and “Psycho-motor” that address the emotional feelings associated with thought process and the correctness of skill performance, respectively. In the cognitive domain, there is ordinarily a sequential progression from knowledge to comprehension, to application, to analysis, to synthesis and finally evaluation. Valid assessment should also aim to

include questions which test the relevant levels of cognitive skill, known as construct validity.

In 1990 psychologist George Miller proposed a framework for assessing clinical competence. At the lowest level of the pyramid is knowledge (knows), followed by competence (knows how), performance (shows how), and action (does). In this framework, Miller distinguished between "action" and the lower levels. "Action" focuses on what occurs in practice rather than what happens in an artificial testing situation. According to Norcini (2003), work-based methods of assessment target this highest level of the pyramid and collect information about doctors' performance in their normal practice. Other common methods of assessment, such as multiple choice questions, simulation tests, and objective structured clinical examinations (OSCE's) target the lower levels of the pyramid. Underlying this distinction is the sensible but still unproved assumption that assessments of actual practice are a much better reflection of routine performance than assessments done under test conditions.

Shumway & Harden (2003) have noted that if a student does not have the knowledge, there will be nothing to comprehend. If a student acquires knowledge but is unable to comprehend the meaning, he/she cannot apply it reasonably. Thus the stratified levels of cognition are interrelated and interdependent in a very dynamic way. Looking at the six levels it should be obvious that all levels of cognition are involved in clinical thought and performance, from history taking, physical examination, diagnosis, differential diagnosis, choice of tests, treatment and prognosis. In clinical diagnosis, knowledge, comprehension and, in most cases, application, are taken for granted. Before a student can be proficient in obtaining clinical information and relating such

information to the pathogenesis and pathophysiology, a certain amount of knowledge of Anatomy, Physiology and Biochemistry must have been acquired to understand the normal structure and function of the human body. Learning to perform the physical examination of a normal individual will enable one to recognise normality and distinguish normal from abnormal, but may not enable one to differentiate one abnormal condition from another. Knowledge of the physical findings in two abnormal conditions is needed to be able to distinguish between them. Thus one requires knowledge of the physical findings in diverse clinical conditions.

Morgan & Cleave-Hogg, (2002) expected a high correlation between students' perceptions of their ability and the degree of their experience. However their study concluded that there was no correlation between experience and performance assessments as well as between students' level of confidence and either clinical or written examination grades. According to the authors, explanations for these findings may include: the quality of the learning experience; the quality and amount of supervision and feedback received during skill acquisition; how important the students perceive the learning of the skill to be; the enthusiasm of the instructor and student in the educational process and the validity of the performance assessment itself.

2.4.2 General aspects of the outcome of teaching-learning

Despite the fact that doctors are expected to have acquired certain skills as part of their undergraduate training, there is substantive evidence (Harden & Gleeson, 1979; Hammar; Forsberg & Loftas, 1995 and Harden *et al.*, 1999) that junior doctors feel

inadequately prepared at the commencement of hospital practice. In part, this could be a result of a mismatch between skills taught and those necessarily required for practice.

The scope and definition of competence and the levels of its attainment is defined in terms of student development within the natural progression in medical school. Consequently, the assessment system will ensure that the expected variation of levels of attainment is defined and assessed. An example of such a framework is the 12-outcomes paradigm of Dundee (Harden, Davis & Crosby, 1997) which describes the following:

- What the doctor is able to do: clinical skills; practical procedures; patient investigations; patient management; health promotion; disease prevention and communication.

- How the doctor approaches his practice: appropriate understanding of basic, social and clinical sciences and underlying principles; with appropriate attitudes and ethical understanding and legal responsibilities and with the appropriate decision-making skills and clinical reasoning and judgment.

- The doctor as a professional: understanding of the doctor's role within the health system and the understanding of personal development.

As Nkanginieme (1997) stressed, making a diagnosis is the pivotal cognitive activity of every practicing doctor. A correct diagnosis will in most cases lead to appropriate treatment. With the high cost of health care, increased patient awareness, medico-

legal and insurance pressures, every doctor must be empathic, accountable and cost-effective in patient care. Diagnosis must therefore always be logical and defensible based on a consideration of the dynamic internal and external environment of a living human. Investigations and treatment must be justifiable on the basis of the patient's situational reality rather than to compensate for the doctor's deficiencies. To the experienced diagnostician, the thought processes involved in formulating a diagnosis are largely subconscious. When asked, most would attribute that capacity to knowledge and experience accumulated over years of practice. In day-to-day life and at the bedside, teachers and learners take the thought process for granted. Some will, at best, look at learning from the point of view of either memorizing or understanding.

In practice, as argued by Miller (1990) a clinician should be able to mentally organize a complete physical examination prior to carrying out the procedure to help assure completeness and accuracy. The clinician should have already formulated some aspects of differential diagnosis based solely on the history and patient interview.

Assessment of clinical skills has formed a key part of medical education for hundreds of years. As stated by Smee (2003), for a reliable measure of clinical skills, performance has to be sampled across a range of patient problems. This is the basic principle underlying the development of objective structured clinical examinations (OSCE's) and the objective structured long case (OSLER). Although the use of OSCE's for skill based assessment is increasingly widespread, modifying more traditional formats may be appropriate when they are combined with other forms of

assessment or are used to screen trainees. The knowledge base of medical students is commonly evaluated by multiple choice examinations. The knowledge base is also examined by oral examinations in some of the required clerkships. Interviewing skills, interpersonal skills, performance and interpretation of the physical examination, the utilization and interpretation of laboratory findings, diagnostic skills, and patient management skills are assessed at the bedside, during case presentations by students, and in one-on-one sessions with attending physicians or residents, (Smee, 2003).

The success of any skill-based assessment depends on finding a suitable balance between validity and reliability and between the ideal and the practical. The oral examination (also known as the "viva") and the "long case" have long been used for assessing clinical competence. The oral examination is traditionally an unstructured face to face session with the examiners. This allows them to explore the trainee's understanding of topics deemed relevant to clinical practice. The long case is patient-based, but the interaction with the patient is usually not observed. Instead, trainees summarise the patient problem for the examiners and respond to examiners' questions about findings, diagnosis or management, and other topics deemed relevant by examiners. The strength of the long case is the validity that comes from the complexities of a complete encounter with a real patient.

A valid clinical examination should assess the components of clinical competence, including the ability to: obtain from the patient a detailed relevant history; carry out a physical examination of the patient; identify the patient's problems from the information obtained and reach a differential diagnosis; identify the appropriate

investigations; interpret the results of the investigations; recommend and undertake appropriate management, including patient education (Chambers, Boulet & Gary, 2000). The necessary physical examination aims to identify the site and type of pathology, loss of function and associated complications. Effectively, as stated by Bates (1995), a physical examination is an evaluation of the body and its functions, using inspection (the check for changes to the normal structural Anatomy), palpation (to determine biomechanical abnormalities and gross deviations of normal Anatomy), percussion, and auscultation that allow the doctor, in conjunction with the personal clinical history, to make an accurate diagnosis. It is clear that sound anatomical knowledge is one of the bases of the ability to conduct a patient examination.

On the other hand, Benor & Hobfoll (1984), stated that the search for valid predictors of clinical performance in the preclinical years has been described across a plethora of studies, most of which agree that academic achievements in the early phases of the medical curriculum are not necessarily related to later clinical performance. Moreover, according to these authors, the applied nature of the knowledge required by the clinician is different from the theoretical and conceptual knowledge traditionally evaluated by the basic scientists. Besides these differences in the realm of knowledge, the clinical clerk is called upon to demonstrate both skills and attitudes but these were seldom evaluated in the pre-clinical phases.

2.4.3 Teaching-learning outcomes related to Anatomy

Butler (1992) has argued that in medical education, the biological sciences, including

Anatomy, are problematical areas because they are taught not just for the acquisition of facts but rather in order that the students may subsequently be equipped to acquire medical knowledge, understand disease processes and treatment rationales, and attain competent clinical skills.

Recent changes in medical education and training require new assessment methods that demonstrate professional attributes that ensure doctors' fitness for practice while adhering to high standards of care (Friedman Ben David *et al*., 2001). This becomes particularly important in the case of medical students who have to demonstrate their ability to understand and apply knowledge, skills and attitudes in different contexts, capabilities difficult to assess using traditional assessment tools.

As described previously, as in other subjects of the medical course, assessment in Anatomy can take many forms. As argued by Challis (1999), the greater the diversity in the methods of assessment, the fairer assessment is to students, taking into account that assessment influences *cognitive* aspects (what and how) as well as *operant* aspects (when and how much) of learning. Selecting an assessment method and matching it to the purpose for which assessment is being carried out will ensure that the things that are important are assessed—not merely the things that are relatively easy to assess (Edelstein *et al*., 2000). However, some misconceptions about written assessments may still exist, one of the most important being the belief that the format of the question determines what the question actually tests. The question's format is of limited importance and that it is the content of the question that determines almost totally what the question tests.

Five criteria can be used to evaluate the advantages and disadvantages of question types: reliability, validity, educational impact, cost effectiveness, and acceptability (Shumway & Harden, 2003). For authors such as Schuwirth & van der Vleuten (2003) and West & Farrow (1996), open ended questions are more flexible—in that they can test issues that require, for example, creativity, spontaneity—but they have lower reliability. Because answering open ended questions is much more time consuming than answering multiple choice questions, they are less suitable for broad sampling. Short answer, open ended questions are not suitable for assessing factual knowledge, which is the basis of assessment in Anatomy, while essays are ideal for assessing how well students can summarise, hypothesise, find relations, and apply known procedures to new situations, which is less common in the context of Anatomy. An objective structured test may be applied particularly for assessing knowledge acquired in the practical context of learning Anatomy.

Although the "spot test" is a common assessment type in Anatomy courses, the level of knowledge required (mostly identification of structures) is still a questionable issue, added to the fact that they are commonly done against stringent time constraints. Oral examinations are considered lesser objective since they can be very informal. In this type of assessment questions may be wide ranging, and in some cases may not be designed to assess any of the learning objectives. Decisions are made according to unknown criteria, as examiners make holistic judgments, (West & Farrow, 1996 and Schuwirth & van der Vleuten, 2003). Oral examinations thus have low reliability and questionable validity.

If teachers are forced to use a particular question type, they will tend to ask about the themes that can be easily assessed with that question type, and they will neglect the topics for which the question type is less well suited (Monkhouse, 1992). Therefore, it is wise to vary the question types in different examinations.

In the context of medical practice the key point of successful medical performance, when assessing a patient, is at least to listen to the patient's history and assess the impact of the symptoms on the patient's normal structure and function (Munro & Campbell, 2002). This is supported by a number of authors (Prior, Silberstein & Stang, 1981 and Heylings, 2002) who have made a plea for a greater emphasis on an understanding of the study of the structure and functions of the living body where the accurate physical examination should be accomplished only after a detailed history is taken to achieve a correct diagnosis.

Undoubtedly, as stated by authors such as Moore & Agur (1995) and Coulehan & Williams (2001) to match these requirements, learning goals in Anatomy should include the knowledge of anatomical vocabulary (Nomina Anatomica) necessary to communicate effectively as a physician; an understanding of the three-dimensionality of the body, and the relationships of body structures; the surface and deep anatomy that is necessary to perform and understand a physical examination of a patient; understanding of anatomical "hot spots" and why these anatomical areas are clinically relevant; understanding the origins of anatomical structure (embryology) and the basis for developmental abnormalities (birth defects); an appreciation of human variation.

However, when these goals are assessed in clinical practice the results do not automatically indicate what sort of training would result in their attainment. In fact, for example, when evaluating the use of anatomical terms by junior doctors in medical reports, Hines (1979) found that in a total of 814 cases, the anatomical terms were consciously employed in only 11% of consultations. It was obvious that anatomical knowledge used by a general practitioner is "living Anatomy" and emphasises the patient's own words. It is of note that over 25% of the cases in Hines's study were involved with bones, joints and muscles. In addition, several studies (Sibley *et al*., 1982; Tracey *et al*., 1997 and Wun, Dickinson & Chan, 2002) show that physicians do not necessarily know what they need to learn in order to improve their competence and choose to re-learn what they already know well.

Issenberg & McGaghie (2002) found that in their junior years students prefer to see the relevance of the skills they are learning in basic sciences, and how they will serve them in practice, while in their senior years students must continue to apply basic sciences to clinical medicine. Apparently in these reported preferences there is recognition that the basic subjects, including Anatomy, are presumed to provide a firm scientific basis for the practice of clinical medicine.

However, as Barrows (1991) claimed, as a consequence of the weak links between the basic and clinical subjects, the knowledge of students may be inconsistent and fragmentary and only a small fraction of the information students memorise for examinations is recalled later when students move into clinical work when they are expected to be able to apply this knowledge in the care of their patients. Assessment plays a fundamental role in driving learning and promoting the development of complex

competencies which require quantitative and qualitative information from different sources as well as professional judgement (van der Vleuten & Schuwirth, 2005) There may therefore be a need to review the assessment procedures in the basic medical sciences, and hence in Anatomy, in order to match the effectiveness of the learning in these disciplines to their intended role in the medical education process.

From the literature reviewed and presented in this chapter it is clear that the learning of Anatomy plays a central and essential role in medical education and the development of clinical competence, but that there is no clear consensus as to the Anatomy content which should be learnt nor to the best teaching, learning and assessment methods which will ensure that what is learnt will be useful, usable and applied appropriately.