A GAME APPROACH TO INTERACTIVE STUDENT-CENTRED LEARNING IN MICROBIOLOGY FOR UNDERGRADUATE MEDICAL STUDENTS

by

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DECLARATION

I declare that this thesis hereby submitted for the degree PhD in Health Professions Education (PhD HPE) at the University of the Free State, is my own independent work and has not previously been submitted by me at another university or faculty. I furthermore cede copyright of the thesis in favour of the University of the Free State.

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MAGDALENA C. STRUWIG

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DATE

Only the curious will learn and only the resolute will overcome the obstacles to learning. The quest quotient has always excited me more than the intelligence quotient.

Eugene S. Wilson

Image retrieved from http://www.google.co.za/imgres?imgurl=http://erddig.typepad.com/nurse_blog/images/children_playing_nurse_7.jpg (26 January 2011).

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[1] Due to time constraints, Questionnaire III was compiled only in English. Afrikaans speaking students were requested to complete the English questionnaire, which they willingly agreed to.

DEDICATION

This work is dedicated to the late Professor Phyllis Botha, former Head of the Department of Medical Microbiology, Faculty of Health Sciences, University of the Free State, and promoter of my MMedSc degree in Medical Microbiology. She brought this magnificent discipline to life for me, and never – even after her untimely death – ceased to inspire me to reach for the stars. Prof, how can I ever forget your passion?

Phyllis Louisa Botha
7 May 1928 - 27 July 1999

You can do anything if you have enthusiasm. Enthusiasm is the yeast that makes your hope rise to the sky. Enthusiasm is the sparkle in your eye, it is the swing in your gait, the grip of your hand, the irresistible surge of your will and your energy to execute your ideas. Enthusiasts are fighters. They have fortitude. They have staying qualities. Enthusiasm is at the bottom of all progress. With it there is accomplishment. Without it there are only alibis....

Henry Ford (1863–1947)

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PART I

GENERAL PERSPECTIVE AND ORIENTATION

We need a new way to look at the complexity of the educational experience – one that regards the apparent 'messiness' and 'imprecision' of play as a deep resource for understanding.

Pat Kane (2004:18)

1 OUTLINE – PART I

Part I of the thesis will familiarise the reader with certain aspects of microbiology and infectious diseases as an integral part of medical students' training, and the position of the Infections module in the undergraduate medical curriculum in the School of Medicine, University of the Free State. The complexity and challenges of the subject will be portrayed. Background information with regard to changes that occurred in medical education over the past decade and contributed to the necessity of an innovative approach to teaching, is presented.

In the section *Problem identification: the reasoning and rationale behind the study*, the author explains from her experience as a lecturer in medical microbiology, students' most commonly expressed complaints about this vast field of study, and how her concern about their dissatisfaction with the subject led to the research question, goals and objectives of the study. A review of the literature informs the reader on play as part of the learning process and the use of educational games in medical training, with specific emphasis on games developed for medical microbiology. Different play theories and definitions are discussed. The section focusing on the research design, paradigm, methodology and strategies, describes the approach followed in the execution of the research. Part I is concluded with an explanation of the context and demarcation of the study and definition of key concepts.

2 INTRODUCTION

Since the latter part of the 20th century, the focal point of healthcare research and funding has shifted, and attention is now predominantly focused on chronic conditions such as cardiovascular disease and cancer (Chow, Ka-lun & Szeto, 2003). Despite this *change in paradigm for medicine* (Chow et al., 2003:881), medical microbiology still enjoys prominence, which is evident from the fact that many diseases regarded by the World Health Organisation (WHO) as critical global problems, are infectious in nature (WHO, 2009; 2010). Examples include the human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis, malaria, cholera and other diarrhoeal diseases, measles, and sexually transmitted infections. Furthermore, certain types of cancer are associated with infectious agents. Cervical cancer, for example, one of the most common malignancies among women in the developing world, is strongly associated with types 16 and 18 of the human papilloma virus (HPV) (Mims, Dockrell, Goering, Roitt, Wakelin & Zuckerman, 2004; WHO, 1999). Infectious diseases are regarded as the biggest killer of children and young adults worldwide, and account for 12–15 million deaths a year, of which approximately 50% occur in developing countries in children younger than five years of age (WHO, 1999).

In her book *Disease: The Extraordinary Stories Behind History's Deadliest Killers*, Mary Dobson (2007) tells the reader about medical conditions that shaped the history of humankind, of which many still continue to have an impact in various parts of the world. Out of thirty diseases discussed in her book, only three – scurvy (vitamin C deficiency), cancer and heart disease – are not of an infectious nature. To highlight the potentially devastating power of an epidemic caused by an infectious agent, Dobson describes plague, caused by *Yersinia pestis*, as *the greatest demographic crisis of the Medieval period, and in terms of the proportion killed, the single most calamitous epidemiological event in all of history* (Dobson, 2007:13).

2.1 Background to the Infections module in the undergraduate medical curriculum at the University of the Free State (UFS)

The field of microbiology and infectious diseases is an essential part of medical students' training. In order to familiarise the reader with the setting, a brief background regarding the position of microbiology in the undergraduate medical curriculum at the University of the Free State (UFS) in Bloemfontein, South Africa, is provided. The School of Medicine in the Faculty of Health Sciences, UFS, introduced a new five-year, modular programme for professional medicine with effect from January 2000. This programme leads to conferral of the MBChB degree. At the time of the research presented in this thesis (2002–2005), Phases I and II of the curriculum (academic years one, two and three), as outlined in Table 1, mostly consisted of scientifically based, pre-clinical modules. Phase III (academic years four and five; not shown in Table 1) involved clinical training.

The vast discipline of microbiology and infectious diseases, dealt with in the Infections module (module code MJR224) as indicated in a black square in Table 1, is one of the basic sciences encountered early in medical training. The Infections module was presented in Semester 4 (that is, the second semester – July to November – of the second academic year). Medical microbiology also formed an integrated part of seven system-specific modules, indicated in grey squares in Table 1. System-specific infections, their microbial causes, symptomatology, treatment and potential complications, were dealt with in more detail in these modules and prepared students for the clinical application of medical microbiology in the next phase of their training.

At the beginning of the 2007 academic year, a revised MBChB programme was implemented, and the pre-clinical and clinical phases of the curriculum are subsequently equally distributed over two-and-a-half years each. Currently, the Infections module is still presented in the second academic year, and each system-specific module contains at least one session dedicated to infections of that particular system. The structure of the curriculum was slightly adapted and clinical training now commences in the second semester of the third academic year, that is, directly after completion of Semester 5.

Table 1. Structure of Phases I and II (first three academic years) of the programme for professional medicine (MBChB degree), UFS, at the time of the study.

[Blocks shaded in grey represent modules in which sessions on system-specific infections were presented.]

PHASE I		**PHASE II**			
Year 1		**Year 2**		**Year 3**	
Semester 1	***Semester 2***	***Semester 3***	***Semester 4***	***Semester 5***	***Semester 6***
MEB113 Health psychology	MEG123 Health policy and service provision	MFN214 Principles of therapy and imaging	GUS224 Urinary system	MEU314 Gastrointestinal system	MEZ324 Human diversity
MEC113 The doctor and the environment	MEH123 Epidemiology and biostatistics	MEO214 Musculo-skeletal system	MEQ224 Immunology & haematology	MEX314 Health and disease in populations	MAE324 Human life cycle
MED113 Concepts of health and disease	MEI123 Molecules of the body	GSM202[#] Special study module	MIS224 Cardiovascular system	MFW314 Respiratory system	MDD324 Ethical and legal aspects of medicine
MEE113 Tissues of the body	MEJ123 Development of the body	GMB214 Metabolism	**MJR224 INFECTIONS**	MEY314 Genital systems	GRE324 Reproduction
MEF113 Structure of the body	MFK123 Electrical systems of the body	GMR214 Membranes and receptors	MFP224 Mechanisms of disease	GEE314 Exocrine and endocrine glands	MGB324 Nervous system
MEA112* General skills		CLINICAL SKILLS MODULE Commences as GKV202 at the beginning of Semester 4, continues throughout the second and third academic years and is evaluated as GKV302 at the end of Semester 6			

*MEA112 (General Skills) was integrated in Phase I modules.

[#]GSM202 commenced in Semester 3 and evaluation of the project report took place in Semester 5 as GSM302.

2.2 Complexity and challenges of the Infections module

Medical microbiology is a complex science. When exposed to the subject for the first time, undergraduate medical students are sometimes warned that they might experience it as similar to learning a new language due to all the unfamiliar names of microorganisms and subject-specific terminology. In addition to numerous taxonomic groups, genera and species of microorganisms, antibiotics used for the treatment of infectious diseases are equally complicated in their classification. An aspect of medical microbiology that initially appears quite confusing to the young medical student, is that one disease can be caused by different

organisms, and the other way round: one organism can be the causative agent of different, clinically unrelated diseases (Mims et al., 2004). To give an elementary example of this complexity, acute bronchitis can be caused by, amongst others, *Haemophilus influenzae* or *Streptococcus pneumoniae*; however, both these organisms can also cause otitis media, sinusitis and meningitis. On the other hand, meningitis can also be caused by, amongst others, *Neisseria meningitidis,* or *Streptococcus agalactiae* and *Listeria monocytogenes* in neonatal cases, as well as *Klebsiella pneumoniae* and numerous different viruses. *Escherichia coli (E. coli),* which is part of the normal flora of the human colon, can be the aetiological agent of meningitis, urinary tract infections, gastroenteritis (Mims et al., 2004) and, although less common, even mastitis (Houpt & Rein, 2003).

Resistance to antibiotics and the different microbial mechanisms of resistance also come into play (Brooks, Butel & Morse, 2001; Mims et al., 2004), further perplexing the basic understanding of infections and how to approach their treatment. In order to make the diagnosis of an infectious disease, the patient's history, clinical signs and symptoms, and several other variables have to be evaluated simultaneously, sometimes with a number of different potentially causative microorganisms in mind. When antibiotic therapy is required, it should be taken into account that the suspected causative organism may possibly be resistant to multiple antibiotics, in which case an alternative agent needs to be considered. These difficulties aside, based on the reality of how frequently infectious diseases are encountered in clinical practice, it can be asserted that doctors need to have a solid foundation in medical microbiology.

A solid foundation in any field, however, does not come easy, nor does it happen by chance. Without any exception, all doctors had once been first-year students when they entered a medical curriculum for the very first time. All aspects of the human life experience, whether going to kindergarten or becoming a neurosurgeon, commence with that specific situation or field of study initially being mastered. When a small child is requested to make a simple drawing of a house, he/she will only be able to do it properly when he/she knows what a triangle is and what a square is, and that the triangle must be situated on top of the square to represent the roof of the house. Thus, even from a very young age, more complex activities

cannot be undertaken successfully unless the basics of that particular activity have been learnt, repeatedly practised, mastered, and consigned to memory, in order to develop a fundamental, yet deep understanding of the elementary components of the more intricate structure (Callaghan, 1999; Hall, 2009). The connection between the child drawing a house and the medical student presenting advanced arguments in the management of a patient with an infectious disease, lies in taking possession of and assimilating the key facts of a subject or topic as a fixed, non-negotiable prerequisite that has to be met before any further steps – such as clinical reasoning – can be considered.

Figure 1 gives a brief outline of the various components – the application of basic, factual information, key concepts and clinical reasoning – involved in the diagnosis and treatment of an infectious disease – in this particular example, childhood meningitis. It portrays an imaginary, yet realistic scenario of parents bringing a sick child to a hospital, the attending doctor's observations, how she uses her knowledge, thoughts and arguments to make a diagnosis, and finally her decision on the patient's treatment. A clinically straightforward case managed by a well-informed doctor, who was academically strong and enjoyed her studies, is used in the scenario. Many cases of infectious diseases, however, are much more complicated than the one illustrated in Figure 1, and many doctors did not obtain top marks in or enjoy the Infections module.

Because of its inherent complexity and the extensive volume of subject content, as depicted in Figure 1, students often find courses dealing with medical microbiology and infectious diseases intimidating and overwhelming (Southwick, Katona, Kauffman, Monroe, Pirofski, Del Rio, Gallis & Dismukes, 2010:19), leading to a lack of gratification and a negative experience of the module.

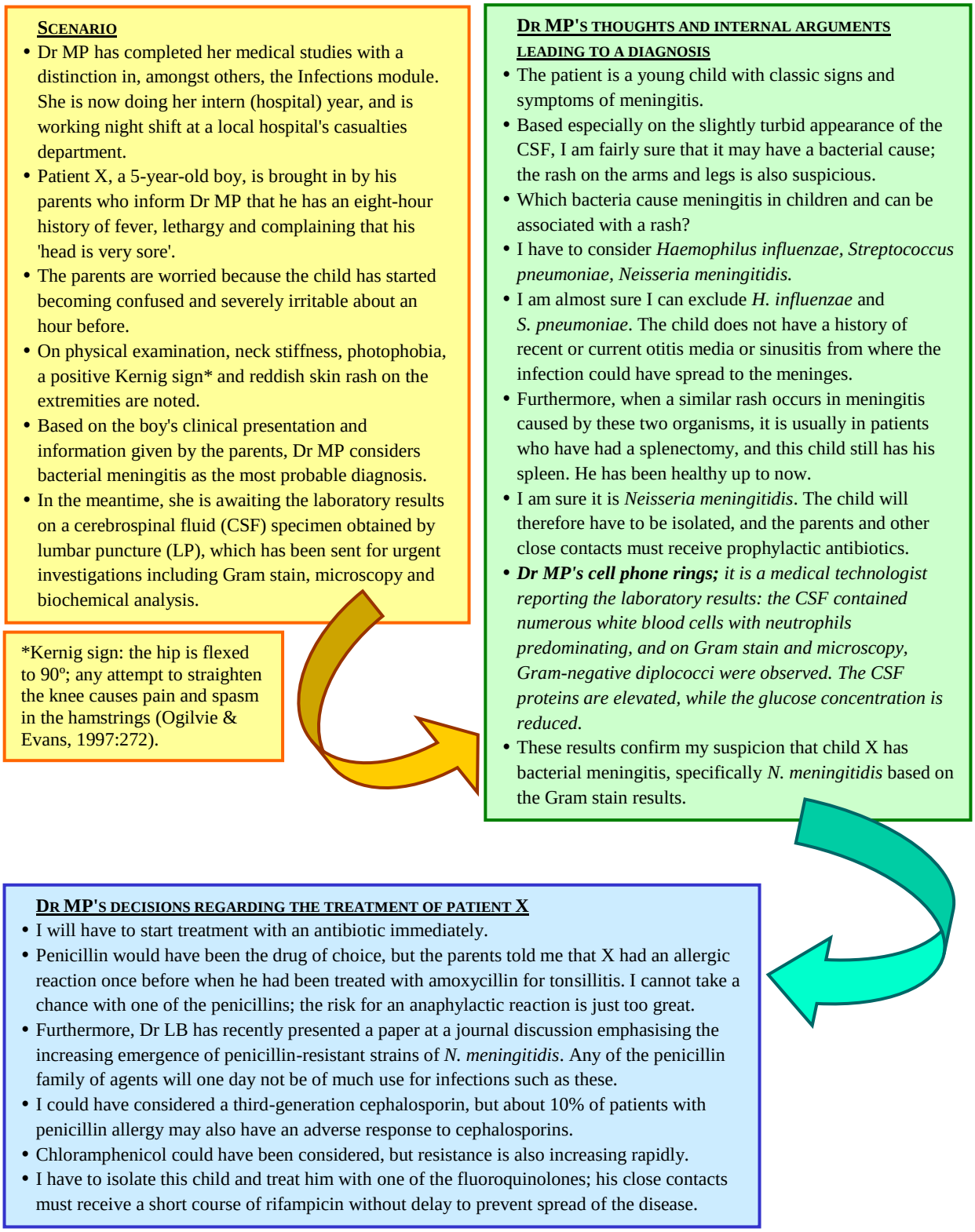


Figure 1. The scenario and the doctor's application of basic knowledge and key concepts, clinical reasoning, and fundamental decision making in a paediatric patient presenting with signs and symptoms of bacterial meningitis (factual content from Tunkel & Scheld, 2003).

2.3 The importance of enthusiasm in teaching and learning

Worldwide, the marks that students obtain in formal assessments are used for measuring their knowledge of a specific subject. It is usually assumed that a student's academic performance in a subject is a fairly credible objective reflection of his/her knowledge and basic understanding of the particular discipline (McAleer, 2001). It could also be argued, however, that the student who obtains good marks has merely employed a strategic approach to learning and has consequently done well in tests and examinations, without really having gained a deeper comprehension of the subject content (Entwistle & Entwistle, 2003). Due to the assessment system currently employed by medical schools in South Africa, marks determine a student's progress. With regard to marks being students' primary motivation to learn, the educationalist, Dorothy de Zouche (1886–1969), once said (De Zouche, 1945:339, 341):

> *If I were asked to enumerate ten educational stupidities, the giving of grades would head the list…. If I can't give a [student] a better reason for studying than a grade on a report card, I ought to lock my desk and go home and stay there.*

By making this statement, and in the rest of her article titled *'The wound is mortal': marks, honors, unsound activities*, De Zouche (1945) explicitly argued that marks are not representative of a student's abilities in general. Ideally, the process of mastering factual content should be accompanied by positive affect, such as enjoyment and enthusiasm, in order to promote higher learning (Ainley, 2006; Bye, Pushkar & Conway, 2007; Craig, Graesser, Sullins & Gholson, 2004; Goleman, 1995; Illeris, 2004; Meyer & Turner, 2006). Therefore, the student should be motivated to excel for the fulfilment and sense of empowerment associated with knowledge, rather than make a reluctant effort simply to be successful when assessed.

Enthusiasm, optimism and hope are unequivocally part of emotional well-being. Emotional intelligence (EQ) can be defined as that part of the human spirit which (i) motivates one to perform, and (ii) provides the energy to demonstrate positive behaviour, including persistence,

creativity, and intuition. It creates in an individual the personal power to develop a positive outlook in order to achieve optimal performance (Goleman, 1995). Success in leadership and the workplace is often attributed to emotional intelligence and regarded as more powerful than intelligence (Kapp, 2000). In a personal interview by O'Neil (1996), Daniel Goleman, author of the best-seller *Emotional Intelligence,* emphasised the relationship between emotional skills and academic success, and stated that emotional intelligence is the primary source of motivation, personal power, innovation and influence. The role of self-knowledge, which includes the ability to set goals, monitor progress, and an awareness of one's own emotional and motivational state, is increasingly emphasised in recent approaches to learning and educational strategies. Issues such as motivation and personal identity are considered to be an integral part of the process of adapting to one's environment (Shepard, Fasko & Osborne, 1999), which, in the case of students, mainly refers to the learning process and acquisition of knowledge, skills and attitudes.

As an emotional experience, enthusiasm cannot be isolated from concepts such as hope, positive affect and optimism. According to Goleman (1995:87), people with high levels of hope (and therefore a positive attitude and feelings of optimism and enthusiasm), are able to motivate themselves, feel resourceful enough to find ways to accomplish their objectives, can reassure themselves when in a difficult situation that things will change for the better, are flexible enough to find different ways to achieve their goals, and have the sense to break down a formidable task into smaller, manageable ones. Kapp (2000) concluded that the value of emotional intelligence in securing success in a variety of situations, including studies, cannot be underestimated. The emotional intelligence and well-being of students could be severely compromised by a lack of enthusiasm, optimism and hope with regard to their studies and academic accomplishments.

A student's perception or experience of a subject plays a vitally important role in the development of enthusiasm for and enjoyment[1] of that particular subject. Konradt, Filip and Hoffmann (2003), and Osborne, Simon and Collins (2003), for example, assert that these

[1] Enjoyment is defined by Csikszentmihalyi, who proposed the flow theory of optimal experience, as *a sense of achievement that occurs when one's skills are matched with the task's challenges* (Garris, Ahlers & Driskell, 2002:452).

properties in a student are fundamental with regard to the learning processes involved in mastering the factual subject content. If a student could identify reasons – external or contributing factors, either real or perceived – that have a negative influence on his/her enjoyment of the subject, the possibility exists that such a student will not feel enthusiastic about the subject. Subsequently, his/her only motivation to master the work will be to pass tests and examinations (Osborne et al., 2003), and therefore to know just enough to produce as many correct answers as possible in an assessment.

Students who do not enjoy a subject will most probably not develop into lifelong learners in that particular subject, for the simple reason that they approach it as something that they just have to get behind their backs as soon as possible, in order to continue with the rest of their studies and obtain their degrees. This perspective is supported by Entwistle (1987), who observed that students who employ a surface approach to learning, substitute focus on meaning of the subject's content with focus on the questions that are anticipated in assessment opportunities, with subsequent memorisation of the information by means of rote learning. Entwistle (1987) asserts that this type of approach is often closely associated with strategic learning, where the primary motivation is to achieve a specific goal (for example, to pass an assessment) and a strategy to achieve this goal, is adopted.

Aiming at educating the working class, early systems of mass education were characterised by the relentless enforcement of facts and figures by dictatorial teachers onto their pupils. This approach resulted in *factory schools producing factory minds*, also referred to as *gradgrindery*[2] (Kane, 2004:43). In secondary school in particular, learning has been equated with the ability to memorise a large amount of factual information often divided into artificial subject areas. Succeeding in assessments that test rote learning is commonly regarded as evidence that the material had been learned to a satisfactory degree (Thatcher, 1990). Walsh (1999) makes the challenging statement that higher education has failed when students learn with the singular purpose of passing a test or obtaining a degree. Consequently, it should be

[2] Derived from the name of the character, Thomas Gradgrind, a disreputable headmaster of a school in the novel *Hard Times* by Charles Dickens (1854). Consequently, Gradgrind's name has been used generically to refer to an unyielding person only interested in and concerned with hard facts and numbers (*Longman Dictionary of Contemporary English*, s.a.).

regarded as the task and the responsibility of faculty members employed by institutions of higher education, to inspire future professionals and direct them towards the development of a positive attitude that includes a love of learning, to accompany them throughout their professional careers.

It can be deduced from the arguments presented, with special reference to De Zouche's (1945) opinion, that a major component of my personal philosophy with regard to teaching involves the importance and necessity of a generous serving of charisma and passion. To the same extent that chickenpox and conjunctivitis are highly contagious, enthusiasm and verve displayed during the presentation of a lecture should be transmitted from the subject expert to the students sitting in the lecture hall (Harden & Crosby, 2000; Radel, Sarrazin, Legrain & Wild, 2010). Scholes' (2002:499) statement that *[e]nthusiasm is infectious within a group, and students know at once when a lecturer is interested in a topic and in teaching itself*, elicits strong agreement.

3 BACKGROUND TO CHANGES IN MEDICAL EDUCATION

Dent (2001a) maintains that medicine is practised and taught in a context that has changed to a radical extent. Moreover, these circumstances and conditions are likely to change even further throughout the course of the 21st century. The changes emphasised by Dent (2001a) are:

- the occurrence of an exponential increase in medical knowledge;
- the role played by the development in information technology;
- different disease patterns;
- changes in the approach to healthcare provision;
- changes in society in general;
- changes in particular in what patients expect from doctors;
- changes in professional boundaries and roles;
- changes in doctors' attitudes to their profession and work; and
- differences in the composition of the student population in many medical schools from what it used to be.

These changes not only influence what is required of doctors, but also the way in which medical education should be approached and presented (Dent, 2001a). In addition to the fact that students today come from a more diverse range of social, ethnic and financial backgrounds than previously, they have also accomplished a greater variety of personal and academic achievements by the time they enter tertiary education. According to Dent (2001a), students have higher expectations of the quality of undergraduate education. Courses promoting the development of abilities such as self-directed learning, problem solving and critical thinking, meet the needs of students better than ones demanding only spoon-feeding and recall of factual knowledge. As far as the changes in doctors' attitudes to their work are concerned, current requirements regarding continuing professional development (CPD) and re-accreditation on a regular basis, demand that self-directed learning skills as a lifelong learning tool be developed early in the process of medical training. Almost two decades ago, the General Medical Council (GMC) of the United Kingdom (1993) suggested the implementation of medical curricula that would produce doctors with appropriate attitudes towards medicine and learning, to equip them for a lifetime of independent education.

Aligned to this view, the Health Professions Council of South Africa (HPCSA, 1999) requires the training of doctors with an attitude towards learning that will guarantee the continuation of learning throughout their professional careers. The HPCSA released a document emphasising in a section entitled *Profile of the Doctor,* that the undergraduate training of medical students should be a period of *learning (knowledge), training (skills) and moulding (attitudes and behaviour)* (HPCSA, 1999:4). An issue highlighted in this document, was the pursuit of CPD by newly qualified physicians who enter into the arena of clinical practice after completion of their medical training. According to the HPCSA (1999:1), one of the primary functions of a medical faculty with regard to health professions education, is *to educate doctors….. whose attitude towards learning is such that it will inspire the continuation of their educational process throughout their professional life.* It was also stated in this document that doctors should strive to become *well-motivated, lifelong learners* (HPCSA, 1999:5).

Dave and Lengrand (cited by Tight, 1998) noted that the term *lifelong learning* was embraced by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 1970.

Lifelong learning denotes (i) keeping yourself informed and up-to-date continuously regarding the subject content; (ii) revising existing knowledge on a continuous basis and integrating new knowledge; (iii) reading and learning about new developments or topics for the sake of being informed, and not only because you have heard about it in the news or a journal discussion; (iv) constantly obtaining new information, not only when you are confronted with a problem for which you cannot find answers or solutions from your existing knowledge (Mattick & Knight, 2007; McManus, 2001).

It has been asserted by Dultz (1999) that it is generally assumed that voluntary learning lacks vigour and discipline. When this point of view is maintained, the presupposition can be made that *people are not naturally interested in learning, are not naturally good at it, and are unlikely to learn effectively and responsibly unless their learning is managed by someone more knowledgeable. It presupposes that the happy and productive learner is one who is prodded and channeled by someone more informed* (Dultz, 1999:110).

With the rapid technological development and explosion of knowledge, it has been estimated that bioscientific information doubles every 20 months (Harden, 2001a), which is an astounding prediction – it has the potential to simultaneously elicit panic and exhilaration. In a similar vein, Brookfield (cited by Harden & Crosby, 2000:334) said in his book *The Skillful Teacher*, that *[t]eaching is the educational equivalent of white water rafting.* Both activities possess distinct components of challenge, excitement, satisfaction, and a sense of achievement, as well as a clear realisation of the risks and responsibilities involved. Harden and Crosby (2000) further elaborate that students' performance during every phase of their training could be related to the quality of the teacher's skills and abilities. This perception had been described almost five decades ago in 1964 when Marris (cited by Hodgson, 1984) mentioned in his book *The Experience of Higher Education*, that in addition to techniques of presentation and clarity of arrangement of the study material, the lecturers' interest in their subjects and also their ability to make it fascinating in a way that students would be stimulated to pursue it further, are valued as most important. According to Dent (2001b), apart from being a mechanism of conveying factual knowledge, lectures probably have a more important role in the sense that they could be utilised to invigorate students' interest and contribute to

self-directed learning in a particular subject or topic. An emotional investment in the process of learning in the form of passion, excellence and commitment, is required for students to become interested and enthusiastic to explore an unfamiliar subject (Lazerson & Wagener, 1999).

Undergraduate medical training is characterised by an emphasis on and intensity of learning. Therefore, the necessity of an approach to learning that involves excitement, fun and motivation for medical teachers and students alike, is pointed out by Vaughn, Gonzalez del Rey and Baker (2001). Innovative teaching and learning approaches pose a challenge to students to do more than what is conventionally required, and to approach their studies from a different pespective, regardless of the statement made by Harden and Lazarus (1985:340) that it is … *easier to move a cemetery than to introduce innovations ... in medical education*. It is not unfounded to argue that students become bored with one-sided presentations. By creating an opportunity for them to voice their opinions in an interactive, small group setting, the curriculum is broadened and an element of enjoyment is added to the learning process. As young adults mature, they are fully capable of participating in their own learning process instead of depending on the traditional forms of rote learning (Fatt, 1998) commonly demonstrated in out-dated, conventional teaching and training strategies.

Would it be unjustified to ask whether all students selected to study medicine at South African universities, are thoroughly equipped to deal with the requirements and challenges of modern day medical training? Until about two decades ago, the South African schooling system hardly promoted self-directed learning, to the detriment of many learners who had the ability and the desire to develop to their full potential independently. According to Walters (1999), for the majority of learners in the South African system the quality of initial education (primary and secondary levels of schooling, Grades 1–12) is still rather poor and needs to be improved dramatically in order for more adults to develop into active, lifelong learners. Although a discussion on the perceived failure of the outcomes-based education (OBE) employed in South African schools since 1998 is beyond the scope of this study, it should be noted that many students coming from this system of schooling have been disadvantaged considerably (Hartdegen, 2009; Masondo, Mahlangu & McLea, 2010). Only their future academic

achievement, if closely monitored at all, would give a reliable indication of the long-term impact of poorly managed OBE in the South African educational setting.

Belanger (cited by Walters, 1999) reported that learners who had a better quality of initial education, tend to participate more in learning activities during the different periods of adult life. As a result of the previously content-based, teacher-centred approach to education, many students attending South African institutes of higher education, including medical schools, often have a surface or superficial approach to learning. Thus, by implication, rote learning is undertaken with little understanding.

Surface learning results in short-term retention of knowledge (Bandaranayake, 2001). With regard to medical students' retention of knowledge acquired early in their training, several studies determined that a variable extent of the basic science knowledge is lost by the time students reach their clinical years (Custers, 2010; Greb, Brennan, McParlane, Page & Bridge, 2009; Krebs, Guilbert, Hofer & Bloch, 1997; Lazić, Dujmović & Hren, 2006; Ling, Swanson, Holtzman & Bucak, 2008; Mateen & D'Eon, 2008; Vadivelu, 2008). For example, Krebs et al. (1997) found in a study investigating the retention of biology facts and concepts over a two-year period, that more than one third of the initial knowledge was lost after two years, and that high achievers tended to lose even more information than low achievers. Lazić et al. (2006) confirm a positive correlation between retained basic science concepts and clinical knowledge.

Based on the changes that have occurred in medical education over the past decade, educators are challenged with the necessity to provide continuing education that supports excellence in clinical practice. Furthermore, they also have to find different approaches to create learning opportunities that are more stimulating, motivating and entertaining. Many obstacles to learning can be overcome by innovative educational techniques, while imagination and creativity are regarded as valuable assets to be employed in the planning and teaching of medical skills and knowledge (Howarth-Hockey & Stride, 2002).

Appropriately presented formal lectures, which should not necessarily be a passive transmission of information, remain effective instruments where whole class teaching is

indispensable (Harden, 2001b). However, interactive small group work that facilitates cooperative learning (Harden, 2001b; Ledingham & Crosby, 2001; Parkyn, 1999; Parsell & Bligh, 1998; Trottier, 1999), independent learning that promotes individual mastery of the learning content and taking responsibility for the learning process (Harden, 2001c; Spencer & Jordan, 1999; Trottier, 1999), is emphasised in the literature.

When involved in autonomous, self-directed learning, the student performs as an active participant, which not only promotes the development of a deep approach to learning, but also provides an educational strategy most likely to produce doctors equipped for lifelong learning (Spencer & Jordan, 1999). Ingenito and Wooles (in Trottier, 1999:43) assert that *diligent students prefer independence in learning.* With regard to group interaction, Trottier (1999) is of the opinion that a Socratic method[3] of active communication in the small group process is more lively than during a lecture, when content-laden facts formally presented leave little room for personal views or a healthy exchange of ideas.

4 PROBLEM IDENTIFICATION: THE REASONING AND RATIONALE BEHIND THE STUDY

A consistent observation over a period of more than ten years of teaching microbiology to undergraduate medical students, was the almost collective lack of enjoyment in learning the subject material. Students realise the importance of a thorough knowledge base in medical microbiology and generally enjoy the exciting and fascinating information that is part of this discipline. However, when it comes to learning the factual content of the subject, many of them fail to experience the degree of enthusiasm considered to be a critical requirement for the development of an attitude that instils independent lifelong learning (Kreber, 2003; Osborne et al., 2003). This lack of enthusiasm for microbiology can be ascribed to several factors contributing to medical students' negative experience and perception of the subject, amongst others, the volume of study material, new terminology and especially the names of microorganisms, complex concepts, the quality of presentations/lectures, and the negative reputation of the subject perpetuated by senior students who tell juniors that medical

[3] Socratic method: a means of arriving at truth by continually questioning, obtaining answers and criticising the answers (Encarta, 1999).

microbiology is a difficult, 'dreadful' module. These observations were confirmed by the results of different questionnaire surveys conducted as part of a quality control programme in the School for Medicine [Beylefeld, 1996 (unpublished data); Bezuidenhout & Nel, 2002 (unpublished data); Bezuidenhout & Van der Westhuizen, 2003 (unpublished data)].

Taking into account the factors contributing to students' adverse experience of medical microbiology and infectious diseases, the following possibilities could potentially have contributed to a solution:

- the reduction in the volume of study material;
- the exclusion of new terminology, names of organisms or complex concepts;
- the quality of the presentation of the subject content; and
- convincing new students in medical microbiology to ignore the negative reputation of the subject.

As far as the volume of the work is concerned, there might have been room for the restriction of study material. However, the module already contains what has been classified by the academic staff in the Department of Medical Microbiology as core knowledge. Due to microbiology being such a vast field of study, and also taking into consideration that medical and scientific knowledge is increasing on a daily basis, it remains a given reality that even core knowledge will appear to most students to be an overwhelming amount of work. Quite often though, students experience the volume of work as overwhelming because, as they admit themselves, they do not start preparing for tests and exams well in advance. In this case, continuous assessment on a weekly basis would prevent students from using the pretext that the work is too much. Still, dividing the volume of work into one- or two-week segments in order to make it more manageable, would not necessarily guarantee that students would be more keen on medical microbiology and enjoy learning it. It could thus be concluded that the solution does not necessarily lie in a reduction of study material.

New terminology, especially the names of microorganisms and complex concepts are inherent components of the subject. Microbiology does not resemble subjects such as mathematics or physics in the sense that students cannot be taught a number of principles and formulae for the

purpose of performing numerous calculations in order to make findings. A student who is not willing to study microbiology in a strictly disciplined manner, will inevitably meet with difficulty. The solution can thus neither be found in the exclusion of new terminology, names of organisms or complex concepts.

What remains is to look critically at the quality of teaching methods and styles. The transmission and explanation of complex concepts and mechanisms are closely linked to the quality of presentation, which differs from one lecturer to the next. All good doctors are not necessarily good teachers. Someone who might be a good teacher on a clinical level, in the laboratory or when assisting students with research – that is, in a practical setting – does not necessarily have the verbal skills and public speaking abilities required when knowledge is imparted during formal lectures. As already pointed out, a lecturer's teaching skills play a very important role in students' perception of a subject. Harden and Crosby (2000) asserted in their paper *The twelve roles of the teacher*, that enthusiasm is one of the most important properties which students are looking for in their teachers. In a more recent study, students' intrinsic motivation has been found to be strongly influenced by their teachers' motivation and teaching style (Radel et al., 2010). However, little can be done when a lecturer's teaching style is not naturally interwoven with enthusiasm, and compassion for students' problems does not enjoy priority.

In numerous personal conversations that the researcher has had over the years, a considerable number of senior students, qualified doctors and even specialists, would mention medical microbiology when asked which subject could be regarded as the single most probable reason for fearing that an academic year would be failed. With regard to the negative reputation of the subject transferred from one year group to the next, it would be of help if lecturers would prepare students from the very beginning that microbiology entails a huge volume of work, and that they would have to master a vast number of new terms.

Against the background of these arguments, the question remained: what could be done at a practical level to influence student learning in medical microbiology in a positive way? If a solution existed, what was the solution and how could it be implemented effectively? Would

its effect be measureable after it has been implemented in practice? Subsequently, the research question was formulated as follows:

> What could be done to change students' perception of microbiology in such a way that they would not only enjoy the subject while they are busy with the Infections module, but enjoy it to such an extent that it would promote the development of skills for lifelong learning?

In view of the researcher's personal experience as a fervent Trivial Pursuit™ player, it only stood to reason to consider the incorporation of a fun aspect in the form of a board game into the learning experience. The process of developing the Med Micro Fun With Facts (MMFWF) board game is described in Part II of the thesis. Figure 2 outlines the reasoning process that resulted from the identification of the research problem and the search for a practical means of addressing students' difficulties with the Infections module.

It is emphasised in the literature that play can be a valuable component in the learning and developmental processes of all individuals – not only in early childhood (Van Leeuwen & Westwood, 2008), but even on a tertiary level of study. A number of studies describing play as a meaningful and effective approach to learning in medical training programmes, have been published (for example, Akl, Mustafa, Slomka, Alawneh, Vedavalli & Schünemann, 2008; Duque, Fung, Mallet, Posel & Fleiszer, 2008; Meterissian, Liberman & McLeod, 2007; Ogershok & Cottrell, 2004; Steinman & Blastos, 2002). Furthermore, a limited number of games with specific focus on aspects of medical microbiology and infectious diseases have been developed (Eswarappa, 2009; Da Rosa, Moreno, Mezzomo & Scroferneker, 2006; Valente, Lora, Landell, Schiefelbein, Girardi, Souza, Zanonato & Scroferneker, 2009). What most of these examples have in common, is that informal learning opportunities result in more effective learning as opposed to when a student must try to memorise a huge amount of work shortly before a test or examination (Handfield-Jones, Nasmith, Steinert & Lawn, 1993; Konradt et al., 2003; Rathunde & Csikszentmihalyi, 1993). Therefore, it was decided to develop the MMFWF board game for students to familiarise themselves with the factual content of medical microbiology.

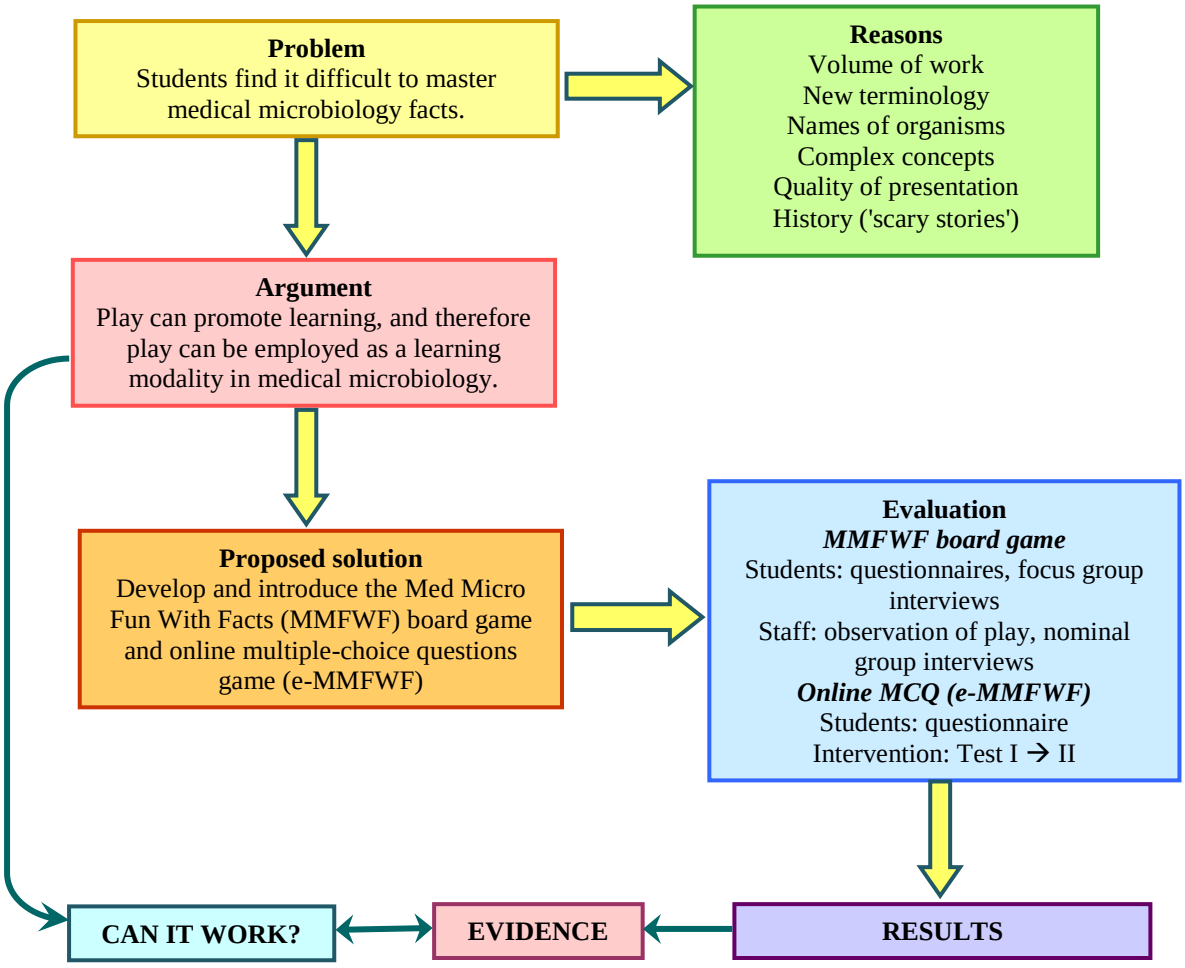


Figure 2. Schematic representation of the reasoning process leading from identification of the problem to proposal of a potential solution.

Apart from exposure to the subject content during an informal, non-threatening learning opportunity, a board game offers other advantages through the honing of general skills such as:

- group work;
- communication and the verbal expression of knowledge;
- consultation of peers as a source of knowledge;
- the usage of other resources in addition to notes, such as textbooks or the internet, to obtain information; and

- the application of the principle *to teach is to learn twice* (Whitman, 1988:s.p.) when an answer or a concept is explained to fellow students.

Over and above different publications that strongly emphasise the development of generic skills in medical students (for example, Beylefeld, 2002; De la Harpe & Radloff, 2000; Rotherham & Willingham, 2009), as well as guidelines and requirements proposed by health professions councils (GMC, 1993; HPCSA, 1999), one article made a strong and lasting impression on the researcher. In his paper *Learning in the company of others*, Parkyn (1999:88) states that

> *[t]he pilgrimage of learning is best made in the company of others.... [A]lthough some preparation for learning must be made alone, the formation of a coherent understanding is best accomplished in the company of others.... For the classroom teacher.... the challenge is to design course content and the learning context in ways that help to develop a vibrant discourse community. Students should recognize that they can, and should, learn from each other; the classroom should represent a community in which members collaborate with each other in learning.*

In addition to mastering the subject content of the Infections module, playing a game could therefore also create opportunities for medical students to develop and improve the general skills required by modern-day educational standards and recommendations (Harden, 2001c). With these potential advantages in mind, a game approach to learning the basic facts of medical microbiology and infectious diseases, was considered worthy of investigation.

5 RESEARCH GOALS AND OBJECTIVES

In order to address the practical problems experienced by students during their training in medical microbiology, as well as the research question formulated in section 4, the aims of the study presented in this thesis were:

- firstly, to develop and refine an innovative instructional tool to be employed by undergraduate medical students as an informal learning opportunity in the field of medical microbiology and infectious diseases; and

- secondly, to investigate the influence of this approach to learning on the students' perception of and attitude towards medical microbiology as a basic, pre-clinical science.

Consequently, the following objectives were proposed to meet the aims of the study:

- to determine by means of an extensive review of the literature the role of play as a potential learning opportunity in higher education in general and in medical training in particular;

- to evaluate by means of a questionnaire (Appendix A; adapted with permission from Du Toit, 1999) medical students' perception of and attitude towards medical microbiology;

- to explore, by means of the same questionnaire, issues related to and factors influencing the process of learning in medical microbiology, namely medical students' self-regulating learning strategies and processing of information while involved in the Infections module;

- to design, compile and produce a quiz-style board game named Med Micro Fun with Facts (MMFWF), which includes a playing board, tokens and 100 question-and-answer cards of which many contain visual material or images supplementary to selected questions (cf. Part II of the thesis);

- to introduce the game by offering it for play to third-year medical students in two different settings, namely:

- in small groups on three consecutive occasions as part of their clinical skills module; and
- on a voluntary, individual basis in the form of a competition (MMFWF Makulu[4] Brain Challenge) in which the winner and runner-up were rewarded with R600 and R400 book vouchers, respectively, sponsored by a local supplier of medical textbooks;

- to evaluate the effectiveness of the game as a potential learning opportunity through:
  - feedback from the students by means of a post-play questionnaire survey (Appendix B);
  - completion of an observation instrument by medically qualified educators in the Faculty of Health Sciences who acted as direct observers of the process of play;
  - semi-structured focus group interviews with students representative of the group who actively participated in the game;
  - nominal group interviews with medical doctors and scientists involved in undergraduate medical education in the Faculty of Health Sciences;

- to convert the board game, with the assistance of a technologically talented colleague in the Faculty of Health Sciences, to an online multiple-choice questions version (e-MMFWF);

- to investigate – as a single case study – the effect of e-MMFWF (implemented as compulsory directed learning following poor test performance) on second-year medical students' achievement in the Infections module;

- to evaluate second-year medical students' experience and opinion of e-MMFWF as a learning modality in the Infections module.

[4] Makulu: big, important (*South African Concise Oxford Dictionary*, 2002).

6 REVIEW OF THE LITERATURE: PLAY AS PART OF THE LEARNING PROCESS AND THE USE OF EDUCATIONAL GAMES IN MEDICAL TRAINING

6.1 Introduction

Dewey (cited by Rathunde & Csikszentmihalyi, 1993) suggested that work and play are two extremes or poles on a continuum. Dewey made a paradoxical statement when he said that the ideal mental state for learning should involve being playful and serious at the same time. With this argument, he implied that in order to become completely engaged in a task, it should be enjoyable, yet also have a clearly specified aim or goal. When these two dimensions of the learning process are at odds, it results in divided interest – according to Dewey, the biggest enemy of effective thinking. When either one of these two components becomes isolated from the other, the outcome will be either fooling or drudgery. Fooling, with too much emphasis on play, is the result of high spontaneous involvement with no goal direction; drudgery, on the other hand, results from low spontaneous involvement and high goal direction when the work aspect of the learning process is overemphasised (Rathunde & Csikszentmihalyi, 1993). It is thus clear that for optimal learning to occur, a subtle balance between work and play has to be found and maintained.

The *Encarta World English Dictionary* (1999:1445) lists more than 20 different uses and interpretations of the word 'play' as a verb, ranging from involvement in enjoyable activities for the sake of amusement, to playing a musical instrument, participating in sport, gambling, speculating the stock market, and the reflection of light on water, to name a few. What is evident from many English dictionaries, is that play is first and foremost described as leisure activities involving enjoyment and fun (*Chambers 21st Century Dictionary,* 1996:1064; *Collins English Dictionary,* 2003:1246; *Encarta World English Dictionary,* 1999:1445), often with particular reference to the spontaneous recreational events in which young children and even animals become engaged.

Although the concept of play can invoke many misconceptions, play is a powerful mediator for learning throughout a person's life. Play is traditionally viewed as applying only to children

and is seen as something that has to be abandoned when grown up. The activity of play may also be regarded as irrelevant or inconsequential to either formal or informal learning (Rieber, 1996). From a work-oriented perspective, play is often perceived as incompatible with any activity supposedly beneficial to the well-being of a community. Negative sociocultural views have led to the assumption that adult play is a superficial and irrelevant deviation from the work ethic (Kane, 2004; Van Leeuwen & Westwood, 2008), associated with *morally rejected idleness* (Van Leeuwen & Westwood, 2008:160).

In her web-based article *The Value of Play,* Mardi Lucich (s.a.) of the California Childcare Health Program gives a striking description of what play as an activity ultimately produces. Although focusing on child development in this particular context, her description can be suitably applied to play at any age and in many different circumstances. She explains the progress and outcome of the play process as follows (Lucich, s.a.:s.p.):

> *... play ... is fun. Play takes many forms, but the heart of play is pleasure. And with pleasure comes the powerful drive to repeat such activities. With repetition comes mastery. And mastery brings a sense of accomplishment and confidence.*

The same characteristics of play in childhood are also applicable to play in adults (Rieber, Smith & Noah, 1998). Research has shown that adults who play, live longer, have improved memory, and are happier in general, reflecting Sutton-Smith's belief that *the opposite of play is not work; it is depression* (Kane, 2004:44). However, Van Leeuwen & Westwood (2008:153) found more than 3 000 English-language, psychological research articles on the PsychINFO database that focused on play in children in the 10-year period prior to 2008, but only 40 articles dealing with play in adults, which predominantly occurred in the context of therapy, could be located, emphasising the lack of, and need for, research on play in adulthood (Van Leeuwen & Westwood, 2008).

6.2 A brief history of play and games

Play and games have been part of the human race since antiquity. According to Beaumont (1994), the idea of games and play as an important part of a child's development can be traced back to the 4th century BC, when the philosophers Plato and Aristotle were already promoting such theories. Plato, for example, wrote that *nothing that is learned under compulsion stays with* (sic) *the mind,* and in order to shape the character of a child between three and six years of age, *there will be need of games* (Beaumont, 1994:30). Although Plato observed that children play games spontaneously, that their play emerge from natural instinct, and that they fabricate games themselves whenever they play together, he suggested that their play should also focus on training to prepare them for an adult profession or occupation (Beaumont, 1994).

Krentz (1999:s.p.) refers to the relationship between play and education in Plato's dramatic dialogue *Republic,* written in the early 4th century BC. Krentz points out that from an etymological perspective, the Greek words for education (*paideia/*παιδεια), play/game/ pastime/sport (*paidia/*παιδια) and children (*paides/*παιδεσ), all share the same root, and often occur in the same context. Against this background, he further argues that the central aim of pedagogy (*paidagogia/*παιδαγογια) is to encourage learning as a form of play (*paidia/* παιδια), and emphasises it as the most influential and effective approach to learning (Krentz, 1999).

One of the oldest board games described in the literature, known as *The Royal Game of Ur*, dates back more than 4 500 years to around 2 600–2 500 BC. It was discovered between 1922 and 1929 by Sir Charles Leonard Wooley (1880–1960), who was involved in the excavation of the Royal Cemetery in the city of Ur in Mesopotamia, approximately 170 km west-northwest of the city of Basra in modern-day Iraq. The game had reportedly been played by royalty and members of the king's court, as well as ordinary citizens of the city (Astral Castle, 2003). Based on its design, the game is also known as the *Game of Twenty Squares,* and examples have been located widely from the eastern Mediterranean countries and Egypt to India. An electronic version of *The Royal Game of Ur* can nowadays be played online via the Mesopotamia link on the British Museum's website (British Museum, s.a.).

Between 1987 and 1993, twenty game boards made of stone were discovered at the site of a military fort in the vicinity of Abu Sha'ar on the Red Sea coast of Egypt, dating back to 309–310 BC. The construction of the fort showed evidence of a special space, presumably a 'gaming room'. It is speculated that Roman soldiers residing at this well-established but remote military station, played games and gambled to pass the time (Mulvin & Sidebotham, 2004).

6.3 Summary of play theories and definitions

Due to the abundance of definitions and interpretations of play behaviour, it is problematic to precisely define play as an activity. From the work of numerous play scholars, theorists and researchers cited by Stagnitti (2004:5), she identifies the characteristic features of play, which propose that play

> *is more internally than externally motivated; transcends as well as reflects reality; is controlled by the player; involves more attention to process than product; is safe; is usually fun, unpredictable, pleasurable; is spontaneous and involves non-obligatory active engagement.*

Stagnitti (2004) concluded that not all theorists agree that intrinsic motivation, explained as the driving force behind an activity performed for autotelic[5] reasons, correlates with other criteria describing play. She therefore argues that play – when viewed from the same perspective as beauty – *is in the eye of the beholder* (Stagnitti, 2004:5).

Mellou (1994) explains that play theories are divided into classical and modern categories, with the classical theories aiming to clarify the existence and purpose of play, while the modern theories mostly focus on the role of play in child development (Mellou, 1994). Stagnitti (2004) also refers to sociocultural theories, and summarises the various play theories as represented in Table 2.

[5] An autotelic activity has within itself the purpose of being performed; it is done for its own sake rather than to gain a material award or avoid punishment (*Encarta World English Dictionary,* 1999:118–119).

Table 2. The theories of play (adapted from Stagnitti, 2004:4).

Theory	Theorist	Year of origin	Summary of theory
Classical theories			
Surplus energy theory	Spencer	1878	Play occurs due to children having excess energy.
Recreation or relaxation theory	Lazarus	1883	Play occurs because children need to restore their energy or relax.
Pre-exercise theory	Groos	1985	Play results from an evolutionary biological process and emerges from instincts and exercises. It serves an adaptive purpose: through play the child constructs adaptive skills that will be required throughout life.
Recapitulation theory	Hall	1920	Play is a product of an evolutionary biological process. Through play, primitive instincts are weakened, and play development follows the evolutionary development of the human race.
Modern theories			
Arousal modulation theories	Berlyne Ellis Hutt	1960 1973 1985	Play is associated with exploration, which reduces the level of arousal when novel situations are encountered. When boredom sets is, arousal increases as a result of exploration. Play is seen as stimulus seeking behaviour. These theories led to the distinction between exploration and play, where in exploration, the child asks 'What can this object do?', while in play, the child asks 'What can I do with this object?'
Psychodynamic theories	Freud Erikson	1961 1985	These theories focus on the role of play in the child's emotional development. Through play, they can play out wish fulfilment and overcome traumatic events.
Cognitive developmental theories	Piaget Vygotsky	1962 1966 1997	Play is a cognitive process and a voluntary activity. It contributes to cognitive development, problem solving and creative thought, and develops innovation, flexibility, enhanced problem solving and adaptation.
Sociocultural theories			
Play as socialisation	Mead	1934	Children learn social rules and norms through play with peers. Social roles are practiced through play.
Metacommunicative theory	Bateson	1955	Play itself is the skill required to function within the real work of daily living. Children frame and reframe roles themselves, while play is learning about learning. Play is affected by the context in which it occurs. Children indicate that they are playing and play is not a vehicle of socialisation needed to develop skills for adulthood.

The theoretical basis most appropriately applicable to the study presented in this thesis, are the modern theories of play as cognitive development proposed by Piaget and Vygotsky (Table 2). According to Rathunde and Csikszentmihalyi (1993), Piaget's dialectical model of play does not focus explicitly on goals, but more on the dynamics between contrasting, yet complementary cognitive-developmental modes. Piaget used the modes of playful and serious activity to communicate his theory, and associated play with assimilation and seriousness with accommodation. Play commences when a predominance of assimilation occurs and reality is integrated into the ego, whereas serious activity grapples with conflicts that are inescapable and is more focused on the demands placed on the ego by external factors such as other persons. The distinction between assimilation and accommodation as proposed by Piaget, however, is one of emphasis rather than separation. Productive thought combines assimilation and accommodation, while dominance of one over the other impairs psychological development (Rathunde & Csikszentmihalyi, 1993).

The other theory related to play as cognitive development (Table 2), concentrates on Vygotsky's theory on the zone of proximal development. The zone of proximal development refers to the gap between children's (students') capacity to achieve something on their own, their potential development as determined by autonomous problem solving, and what they can accomplish through problem solving with adult (tutor) assistance and encouragement, or in joining forces with more competent peers (Wood & Wood, 1996:5). Vygotsky proposed that children internalise the meaning of words as they talk, and that language could only be internalised through active communication. As children begin to use new words in the presence of a more experienced or better informed person, such as a parent, an older sibling or peer, they enter a zone located somewhere between the child's current and potential understanding – the zone of proximal development. A more capable person can add meaning to what the child is acquainted with. From an educational perspective, the teacher (tutor; more capable peer) can contribute to the child's (student's) existing knowledge base by providing new information to assimilate with present knowledge, and by taking him/her from the familiar to the unfamiliar (Steele, 1999).

Closely paralleled to Vygotsky's theory on the zone of proximal development, Wood, Bruner and Ross (1976) proposed the metaphor of 'scaffolding' in the context of tutorial interaction between adults (or more capable peers) and children – or, in the context of this research, between students and more capable fellow students. Both scaffolding and Vygotsky's zone of proximal development are applicable to adult or peer tutoring and collaborative learning. Rogoff (cited by Wood & Wood, 1996) identified a number of general characteristics of effective collaboration between peers, or between tutors and students. Tutors – or more capable peers – provide a bridge between a student's existing knowledge and skills, and the demands of the new task. On their own, less capable students may experience difficulty to make a relevant connection between what the new task requires and what they already know. By assisting with instructions and guidance in the context of the learning activity, tutors (or more capable peers) provide support for development of the student's problem solving skills. Guided participation ensures that students play an active role in learning and emphasises their contribution to the successful solution of problems, while at the same time, effective guidance transfers responsibility from the tutor to the student. Apart from formal learning situations, these interactions may also occur when individuals are involved in playful encounters (Wood & Wood, 1996).

6.4 Sutton-Smith's rhetorics of play

The play scholar, Brian Sutton-Smith, renowned for his international best-seller *The Ambiguity of Play* (Sutton-Smith, 1997), argues that (Sutton-Smith, 1975:214),

> *[a]s the modern world seems to be excessively confusing and complex in its problems and demands, ... any education system that did not maximize a child's play capacities is guiding him down a blind alley. Any education system that lets a child go forth with play deficits leaves him ill equipped for what lies ahead.*

Sutton-Smith (1997) proposes seven rhetorics – or modes of expression – with regard to general themes and traditions of play. The seven rhetorics are divided into two groups, namely

the modern and the ancient rhetorics of play, with the seventh rhetoric separately regarded as both ancient and modern. Sutton-Smith's play rhetorics are summarised by Kane (2004:15) as follows:

The ancient rhetorics

- play as power (the contest of players – in sport, markets, law, war, even philosophy);
- play as identity (the play of the carnival, the binding rituals of community);
- play as fate and chaos (the play of chance – gambling, risk, the cosmos at play);

The modern rhetorics

- play as progress (play in education, as healthy development);
- play as imagination (play as art, scientific hypothesis, culture);
- play as selfhood (play as freedom, voluntarism, personal happiness – the expression of individuality);

The seventh rhetoric (viewed as both an ancient and modern rhetoric)

- play as frivolity (the puritan stereotype of play as laughter, subversion, rebellion; inversion, reversal of order, opposite to convention; tomfoolery misbehaviour, disobedience).

For the purpose of this thesis, the emphasis will fall on play as progress, and play as power. Play as progress is described by Kane (2004:41) as modern play presenting its *most virtuous face*, referring to children being both pupils and teachers. In this context, he regards children as *the front-line troops of social progress,* and therefore play is accepted as useful and functional. In childhood, play allows the unconscious testing and investigation of strategies for survival in an environment that does not pose the threat of risk. Furthermore, play is associated with optimism, positive affect and energy, thus expressing the child's – and therefore society's – potential for progress. Play as power represents play as either or both of the two most important forms of contest encountered in society, namely the contests of physical and intellectual skills (Kane, 2004).

Historically, as explained by Kane (2004), play as progress was at a peak when individuals such as Friedrich Froebel (1782–1852) and Maria Montessori (1870–1952) dedicated themselves to the creation of school systems that would capture the playful enthusiasm of children. In the Montessori schools, for example, progress was measured by the extent to which the child's playfulness and creativity were respected and utilised by teachers (Kane, 2004:41–44).

Based on sophisticated techniques in brain imaging, it has been found in both human and primate individuals that play improves brain power at a very crucial formative stage, and the act of playing strengthens and extends the number of neuronal connections in the brain (Furlow, cited by Kane, 2004: 40). Regardless of the proven benefits of play, parents are still concerned that play interferes negatively with their child's progress and development. The negative attitude towards play can be attributed to the level of importance given to the work ethic assumed in the development of Western civilisation. According to the work ethic, men/women have to justify their existence through performing productive work, where play is regarded as interfering with essential work activities and seems to be worthless as it does not create or result in a useful product. Allowing children to play is particularly difficult in societies where the struggle for subsistence is challenging. Children have to either work themselves, or take care of siblings to allow the parents sufficient time to work and supply in the needs of the family (Sutton-Smith, 1975). However, when parents accept the point of view that play facilitates progress and contributes to the child's cognitive and educational development, they are more likely to join their children in play activities (Farver, Kim & Lee, cited by Sutton-Smith, 1997).

In his book *The Ambiguity of Play,* Sutton-Smith (1997) devotes a chapter titled *Rhetorics of Power,* to the discussion of the different forms of play that occur in adulthood. He asserts that the major form of human play involves contests. Depending on the type of 'game', play can thus be regarded as a form of individual power expression, in the sense that play and power fit into various descriptions such as *warfare, hegemony, conflict, **competition,** glory, manliness, **contest,** and resistance* (Sutton-Smith, 1997:75; bold emphasis added). From a social perspective, the general idea of the power rhetoric is that play – games, sports, athletics, or any

activity that has to do with some sort of contest or competition between two parties (individuals, communities, tribes, social classes, ethnic groups, nations) – exists because it represents or expresses an actual struggle between these parties. The side or team that walks out of the contest triumphantly, brings praise and recognition to its own group, and strengthens the bond between individual members of the group through their collective identity and shared victory. Although it certainly depends on the specific context, the two opposing parties often have a mutual enthusiasm for their particular type of contest, which may therefore unite rather than divide them (Sutton-Smith, 1997).

The rhetoric of play as power deserves attention in this context since the MMFWF board game evokes not only amicable rivalry between teams, but also a strong element of cooperation within teams. Another powerful feature of MMFWF is the typical component of shared enthusiasm experienced by the whole group of participants, despite the competitive nature of the game, as explained by Sutton-Smith (1997).

6.5 Play and Csikszentmihalyi's flow theory

The flow theory of optimal experience, developed by Mihaly Csikszentmihalyi (1996, 2002), describes an emotional or mental state in which people become so involved in an activity that nothing else seems to matter. The experience is regarded as gratifying, to such an extent that people will do it for the sheer sake of doing it, even without the prospect of any material reward. One result of flow is psychological growth by means of differentiation (the need for an individual to remain unique from others) and integration (the need to feel connected to other people and ideas). Flow is derived from activities that provide enjoyment, which results when one or more of the following occurs (Csikszentmihalyi, 1996, 2002; Rieber, 1996):

- challenge is optimised;
- the participant's attention is completely absorbed in the activity;
- the activity has clear goals;
- the activity provides clear and consistent feedback as to whether one is reaching the goals;

- the activity is so absorbing that it frees the individual, at least temporarily, from other worries and frustrations;
- the individual feels completely in control of the activity;
- all feelings of self-consciousness disappear; and/or
- time is transformed during the activity (that is, hours pass without noticing).

It therefore does not come as a surprise that these components, which contribute to enjoyment experienced during flow, are consistent with and characteristic of play. Motivational researchers regard certain distinctive features, namely challenge, curiosity, fantasy and control, as common to all intrinsically motivating learning environments. Games represent the instructional artefact most closely matching these characteristics. For example, fantasy is used to encourage learners to imagine that they are completing the activity in a context in which they are not really present (Rieber, 1996). Participation in a quiz-like game could thus be imagined as taking an oral examination, which, in the real-life situation, is an extremely stressful and threatening experience for most students.

6.6 Play and games in education

With regard to play as an active component of education, the theoretical foundations for simulations, games, and other forms of interactive, experience-based learning, had been in place since ancient times (Ruben, 1999). Educational games can be defined as instructional activities where learners are provided with motivation, entertainment, competition and reinforcement, which should motivate learners to enjoy an experience where the transmission of knowledge takes place (Herselman, 2000). Rieber (2001:2) sees learning and motivation as an inseparable combination, and asserts that he has *come to view motivation as the more important of the two*. He believes that learning without emotional and passionate involvement in the process is short-lived, and further argues that the concept of play provides the best opportunity to fuse cognition and motivation within learning environments (Rieber, 2001).

The question has persistently been raised, however, amongst others by Prensky (2002:3), whether *the goals of rigorous learning and having fun [are] incompatible and mutually*

exclusive. Prensky continues to argue that many academics share the point of view that having fun while learning is not feasible, and that for the most part, the curricular component of tertiary study is painful, often drudgery. Consequently, academics with such an unyielding mindset *resist any efforts to make learning fun, passing the same pain down, generation after generation, as an 'academic rite of passage'* (Prensky, 2002:3).

Bisson and Luckner (1996) assert that the role of fun with regard to intrinsic motivation in the learning process is twofold. In the first place, intrinsic motivation promotes the desire for repetition or recurrence of the experience; and secondly, fun motivates students to engage themselves in activities with which they have little or no previous experience (Bisson & Luckner, 1996). As noted by Lucich (s.a.), repetition ultimately results in mastery, while a new experience, especially when it is challenging, enjoyable and rewarding, creates a state of flow and thus promotes effective learning (Csikszentmihalyi, 1996, 2002; Rieber, 1996). Games offer many advantages by having the potential to meet most of the characteristics of intrinsic motivation, which in turn improves the quality of the learning experience by adding fun to the process for both students and teachers (Handfield-Jones et al., 1993).

Games and simulations, seen as experience-based or experiential instructional methods, involve more complex and diverse approaches to the learning process and outcomes; promote interactivity, collaboration and peer learning; allow for addressing cognitive as well as affective learning issues; and, perhaps most important, foster active learning (Ruben, 1999). Learning should be seen as a process which does not have an end, but continues throughout the life of the individual. Fundamental to all learning is some kind of dynamic experience in which the learner has to be actively involved. When a game is used as a learning and/or teaching tool, the teacher has no control over the process of learning, and the participants continue independently for the largest part of the learning process. The teacher's task is then limited to monitoring or observing the process, abstaining from interference (Thatcher, 1990). The thrill of overcoming an obstacle, although not in the sense of excelling at the expense of someone else, provides an excellent motivational tool to encourage participation. The fundamental difference between work and play lies in the degree of freedom the participants are allowed to exercise. Furthermore, the use of games in education often leads to the

development of an ongoing, fulfilling relationship between the students as players and the teacher as 'coach' (Schwartzman, 1997).

Numerous educational games have been developed and described in the literature, ranging from games focusing on the development of language proficiency (Herselman, 2000), learning a second language (Gaudart, 1999; Herselman, 2000), and cultural diversity (Neves & Sanyal, 1997), to biology (Franklin, Peat & Lewis, 2003), physics (Rieber & Matzko, 2001), mathematics (Adaramola & Alamina, 2008), strategic business management (Knotts & Keys, 1997), sustainable development (Torres & Macedo, 2000), military tactics (Kirk, 1997), and even a game to teach children the skills required for and benefits of reading a daily newspaper (Strupp, 1999).

6.7 The use of educational games in medical training

The first games for under- and postgraduate medical and other health-related training were developed and introduced during the 1970s (Bochennek, Wittekindt, Zimmermann & Klingebiel, 2007). To locate literature reporting the use of games in medical education, an exhaustive literature search was conducted on NCBI (National Center for Biotechnology Information) Pubmed and EBSCOhost, which included the databases Academic Search Complete, Africa-Wide Information, CINAHL (the Cumulative Index to Nursing and Allied Health), ERIC (the Education Resources Information Center), Health Source: Nursing/Academic edition, Masterfile Premier, Medline, PsycARTICLES and PsycINFO, using the search terms *medical education, teaching, learning, play* and *games* and appropriate synonyms in various combinations. The references cited in articles retrieved in the primary literature search were further assessed for additional articles not located electronically. For the purpose of the thesis, the emphasis will be on games specifically related to medical microbiology and infectious diseases. Selected games developed for use in other areas of medical training will be briefly discussed, with the focus mainly on the evaluation of these games as learning tools.

6.7.1 Miscellaneous medical games excluding games on medical microbiology and infectious diseases

In preparation of a Cochrane systematic review of the literature reporting the effect of educational games on health professionals' performance, knowledge, skills, attitudes and satisfaction, Akl, Sackett, Pretorius, Bhoopathi, Mustafa, Schünemann and Erdley (2009) retrieved 1 109 unique citations by means of a rigorous search strategy. Upon screening the titles and abstracts, 55 citations were identified as potentially eligible for inclusion in the review, of which one was a randomised controlled trial. One of the requirements for inclusion of an article was that the game described should have an element of competitiveness (Akl et al., 2009). Their review confirms the wide use of educational games in medical training.

Educational games for medical training cover a substantial variety of topics and disciplines in medicine, and deal with, amongst others, the teaching of clinical practice guidelines in internal medicine (Akl et al., 2008), asthma management (Boulet, 2007), viral hepatitis (Da Rosa et al., 2006), making geriatric house calls (Duque et al., 2008), overactive bladder and benign prostatic hyperplasia (LeCroy, 2006), cancer genetics (Nosek, Cohen, Matthews, Papp, Wolf, Wrenn, Sher, Coulter, Martin & Wiesner, 2006), paediatrics (Ogershok & Cottrell, 2004; Sward, Richardson, Kendrick & Maloney, 2008), pharmacokinetics (Persky, Stegall-Zanation & Dupuis, 2007), immunology (Eckert, Da Rosa, Busnello, Melchior, Masiero & Scroferneker, 2004; Girardi, Nieto, Vitória, Vieira, Guimaráes, Salvador & Scroferneker, 2006; Steinman & Blastos, 2002), physiology (Howard, Collins & DiCarlo, 2002; Zakaryan, Bliss & Sarvazyan, 2005) and prescription writing (Rajasekaran, Senthilkumar & Gowda, 2008).

In virtually all of the articles retrieved for the study presented in this thesis, the author(s) reported that the game described was rated by the majority of the respective users as enjoyable, a positive learning experience, and as promoting interaction and active participation. For example, evaluation of *The Pediatric Board Game* (Ogershok & Cottrell, 2004) showed that 89.2% of the medical students (n=37) who played the game strongly agreed that the game was entertaining and fun to play; 91.9% strongly agreed that the game provided

excellent educational value in the field of paediatrics, and 97.3% indicated that they would prefer to play the game occasionally rather than attend a regular lecture. Eighty-three percent (83%) of the paediatric residents (n=12) who played the game strongly agreed that knowing the answers to all 400 the questions included in the game, would provide them with a good foundation of core knowledge in paediatrics. Six (85.7%) members of staff (n=7) who facilitated the game strongly agreed that the game provided excellent educational value, and that they would occasionally use the game in their teaching instead of presenting a formal lecture (Ogershok & Cottrell, 2004).

In a study by Roberts (2008), students did not only play educational board games in genetics and haematology; they were actively involved in the games' design and production, as well as the collection of questions included in the games. Eighty-eight percent (88%) of the students (n=72) who participated pointed out that the activity resulted in effective cooperation between team members, and that they enjoyed creating and playing the board games. In addition, 92% indicated that compiling the questions and answers for the games facilitated student learning (Roberts, 2008).

Howard et al. (2002) used a game based on the television reality series *Survivor*, to review respiratory physiology. They used a standard 5-point Likert scale evaluation instrument to obtain students' opinion on the game after playing. Mean scores (± standard deviations) allocated to the different statements ranged between 3.8 ± 0.08 and 4.7 ± 0.04. From the students' feedback, it was evident that they rated the game as interesting and stimulating, challenging yet appropriate for their level of education, and as promoting participation and collaboration, with the latter facilitating their understanding of respiratory physiology (Howard et al., 2002).

A Bingo-like game used as a supplementary class activity to promote students' interaction with the study material in an introductory clinical pharmacy skills course, was invented by Tietze (2007). Fifty-four (96.4%) students (n=56) who participated in the activity agreed that the game should continue to be included in the course. Sixty percent (60%) of participants indicated that the game facilitated review of the study material, while 46.4% indicated that

playing the game reduced the pressure usually experienced with written examinations (Tietze, 2007).

6.7.2 Educational games with a focus on medical microbiology and infectious diseases

Less than 10 articles on educational games with an emphasis on medical microbiology and infectious diseases or closely related issues, could be located by means of the literature search described in section 6.7. Included among these articles are two that were published on the research done with regard to the MMFWF board game (Beylefeld & Struwig, 2007; Struwig, Beylefeld & Hugo, 2005). Reports in the literature on medical microbiology games and related topics are briefly summarised in Table 3.

Three of the games listed in Table 3 were developed specifically with medical students as the intended user audience. These games are the the viral hepatitis game (Da Rosa et al., 2006), the host defence game (Steinman & Blastos, 2002), and the game on antimicrobial mechanisms of action (Valente et al., 2009). The host defence game (Table 3, reference 6) as described by Steinman and Blastos (2002) can also be classified as an immunology game, rather than focusing purely on medical microbiology. In comparison to the games listed in Table 3, the MMFWF game covers medical microbiology and infectious diseases as a complete discipline and does not focus on only one selected aspect of the field.

Table 3. Summary of literature reporting medical microbiology and infectious diseases educational games (listed in alphabetical order according to authors).

Ref.*	Name or topic of the game	Type of game Brief description of the content	Intended users
1	Viral hepatitis	*Card game* Covers the epidemiological, clinical and immunological aspects of hepatitis A, B, C, D and E	Medical students
2	HEALTHSIMNET; HIV/AIDS	*Interactive, narrative-type game* Intended for improving practice in an HIV/AIDS healthcare network	Healthcare professionals
3	AIDS game	*Unknown* Teaches the epidemiology, clinical features and prevention of HIV infection and AIDS	Adolescents
4	Location of pathogenic bacteria during persistent infections	*Mathematical principles of game theory, calculation of the Nash equilibrium* Provides insight into the location of pathogens in the host during persistent infections by using game theory; the pathogen and the host are the two 'players' using specific 'strategies'	[#]
5	Dengue haemorrhagic fever (DHF)	*Board game* Promotes knowledge of DHF in an endemic area of the disease	Philippine school children and adolescents
6	Host defence (immune response to pathogens and cancer)	*Card game* Cards represent 25 infectious agents or cancers, 30 defence mechanisms and 6 conditions to modify health status	Adolescents and medical students
7	Antimicrobial mechanisms of action	*Board game* Teaches concepts of antimicrobial mechanisms of action, susceptibility and resistance to antibiotics, mutations involved in resistance and alternative agents to use against resistant pathogens	Medical students; pharmacology students

*References. **1.** Da Rosa et al. (2006); **2.** Dobson & Ha (2008); **3.** Dodd (1995); **4.** Eswarappa (2009); **5.** Lennon & Coombs (2007); **6.** Steinman & Blastos (2002); **7.** Valente et al. (2009).

[#]The author (Eswarappa, 2009) does not indicate the intended user audience in his article. Based on the degree of difficulty and highly specialised focus of the game, it appears as if the game could be found useful by specialised individuals in both the fields of microbial pathogenesis and game development.

Table 4 shows a comparison of the feedback received on the evaluation of similar aspects of the games on viral hepatitis (Da Rosa et al., 2006) and antimicrobial agents (Valente et al., 2009). The game on host defence was excluded from this comparison as the authors presented their participants' feedback in terms of categories according to the Likert scale values (for example, in response to the question 'Was the game enjoyable?', participants could select between options ranging from 'very little' to 'very much'). The host defence game was also excluded due to the fact that only eight (5.6%) out of a possible 144 students from the target sample participated in the game. It should be noted, however, that the small number of medical students who did participate in the host defence game, gave very positive feedback on aspects such as the level of enjoyment and learning from the game (Steinman & Blastos, 2002).

Table 4. Comparison of feedback received on the evaluation of two microbiology-related games developed with medical students as the intended user audience.

Feature of game evaluated	**Positive responses**	
	Viral hepatitis (Da Rosa et al., 2006) **(n=140)**	**Antimicrobial agents (**Valente et al., 2009) **(n=42)**
The game resulted in better understanding of the subject.	85.0%	90.5%
The game improved students' knowledge of the topic/subject content.	ND*	97.6%
The game can be used as an important and meaningful tool to enhance learning.	75.0%	85.7%
The game encouraged clinical thinking.	92.1%	78.6%
The content of the game was difficult.	ND*	43.6%

*ND: not determined

In contrast to the application of the MMFWF board game, the games on viral hepatitis (Da Rosa et al., 2006), antimicrobial agents' mechanisms of action (Valente et al., 2009), and the host defence game (Steinman & Blastos, 2002), were primarily investigating pre- and post-test scores obtained by students before and after playing these games, thus focusing mainly on the acquisition of knowledge. Furthermore, the MMFWF board game not only covered the wide field of medical microbiology as a whole, but also differed from these games with regard to

the motivation for evaluating the game. The MMFWF game was evaluated by students who had successfully completed the Infections module of their undergraduate medical curriculum, with one of the principal objectives to determine the impact of the game on students' attitudes towards and perceptions of medical microbiology and infectious diseases (Beylefeld & Struwig, 2007; Struwig et al., 2005).

6.8 Concluding remarks

Different approaches and modalities can be used as teaching and learning tools to comply with students' needs and expectations (Reese, 1998). A valid argument against teaching exclusively by means of lectures, is made by Reese (1998:6) who asserts that

> *.... the effectiveness of lectures alone is limited because students are passive recipients of information.... Lectures discourage curiosity by limiting the student's ability and incentive to explore areas of interest not directly covered. Perhaps most important, lectures do not address the development of higher order cognitive skills.*

From the extensive body of information available on the role and importance of play in the learning process – not only as part of children's social, cognitive and emotional development, but certainly also during various stages of adulthood – it is evident that play and games have a solid place in medical education and are worthy of further investigation.

7 RESEARCH DESIGN: PARADIGM, METHODOLOGY AND STRATEGIES

7.1 Introduction

The decision to undertake a research project is usually prompted by a specific source from which a research problem can be identified, which includes (i) the observation of reality; (ii) theory; (iii) previous research; (iv) curiosity; and (v) the supervisor as a source of research ideas (Fouché, 2002a). The research presented in this thesis was first and foremost instigated

by a combination of two of these sources, namely the observation of reality and personal curiosity. Therefore, these two sources in particular, as part of the reasoning process, will be discussed in more detail below.

An observation of reality – the identification of a real-life problem – was made when it became evident that students were not positively inclined towards medical microbiology. The background to this statement is made clear in section 4: *Problem identification: the reasoning and rationale behind the study*. When the existence of a problem with so many potentially adverse consequences is identified by an academic member of staff involved in the module, he/she has to take the initiative and responsibility to actively look for solutions. In this particular case, I was the module leader at that time, and became increasingly concerned with doing something to resolve the students' difficulties. As expounded in section 4, several potential solutions could have been considered in an attempt to address the students' grievances, which have all been argued to be difficult to accomplish. Although firmly convinced that a lecturer has a professional obligation to present his/her classes in a manner that will optimally capture students' interest and attention, I understood that my personal opinion on the quality of teaching in medical microbiology could not be imposed on differently-minded colleagues without creating uncomfortable consequences. This realisation eventually led to the conclusion that if something had to be done to change students' attitude towards and experience of medical microbiology, enjoyment should be generated from a completely different angle to what they had been used to. At that time, their exposure to the subject content exclusively consisted of attending lectures and passively absorbing and memorising facts with the main objective to pass the module.

Recognising that a special effort and an unusual approach would be necessary to address the problems observed in practice, the idea that a board game could promote informal, interactive and pleasurable exposure to the factual content of the subject, was seriously considered. Finding answers to the question asked out of curiosity – can students master medical microbiology facts while at the same time playing a game, having fun and enjoying the learning process? – developed into an urgent and important personal concern. I wanted to design, develop and produce an entertaining, user-friendly product not only promoting

enjoyment of the learning process, but also providing students with a useful, substantial databank of subject-specific questions and answers. Although not the primary objective of the game, creating conditions that would enhance the development of general skills such as communication, collaborative learning, and verbal expression of knowledge – 'speaking microbiology' – could represent a valuable feature of the product.

Fouché (2002a) asserts that when curiosity takes a major place in the development of the research proposal and process, it should be anticipated that the researcher's personality and temperament will possibly also play an important role. Although it is seen as the ideal that an investigation is motivated by the researcher's inquisitiveness and personal interest, no scientist can afford the indulgence of being driven by curiosity alone. Factors such as the practical value and feasibility of the research outcomes need to be taken into consideration (Fouché, 2002a). Based on these arguments, it was necessary to engage in critical deliberation on the prospective usefulness and potential practical application of the MMFWF game in the Infections module of the medical curriculum. I aspired to create a product – an artefact – in the field of medical microbiology, totally different from the passive lecture approach; a practically usable product. The ideal outcome would be if students who were exposed to the game, would reminisce with cheer how it changed their perception of microbiology, inspiring them to do more reading and harvest more information, and how much fun it was to play it with their classmates and exchange ideas with them.

Before continuing, it is deemed necessary to explain the strong preference for the textbook by Teddlie and Tashakkori (2009), titled *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*, cited abundantly throughout this section of the thesis. The inclination towards Teddlie and Tashakkori was determined mostly by personal choice, and neither resulted from prior knowledge of the book, nor did any recommendations or reviews have an influence. On its back cover, it is stated that this book is a *unique, interdisciplinary text written by two leaders in the field*, and that the authors *present an all-inclusive approach to mixed methods research* (Teddlie & Tashakkori, 2009: back cover). In addition to the more than 500 references cited, the authors provide an exhaustive glossary of almost 300 terms and definitions associated with

mixed methods, securing it as a commendable sourcebook. These features contributed to a large extent to the decision to use Teddlie and Tashakkori (2009) as a primary source.

7.2 Research design

When one reads the literature on research methodology, an abundance of terms and definitions that are often used interchangeably, or differently depending on the context, is encountered. In order to clarify the terminology, methodology as a concept was viewed from a personal perspective as a hierarchy, with the paradigm represented by the top of an imaginary triangle, and data generated by the research forming the base of the triangle. To further explain this line of reasoning, the concept is illustrated in Figure 3. The concepts of paradigm, methodology, strategies and methods are, for the purpose of this study, collectively referred to as the research design, indicated in Figure 3 as a dashed-line triangle. The arrow in Figure 3 emphasises the descending hierarchy of levels from paradigm to data.

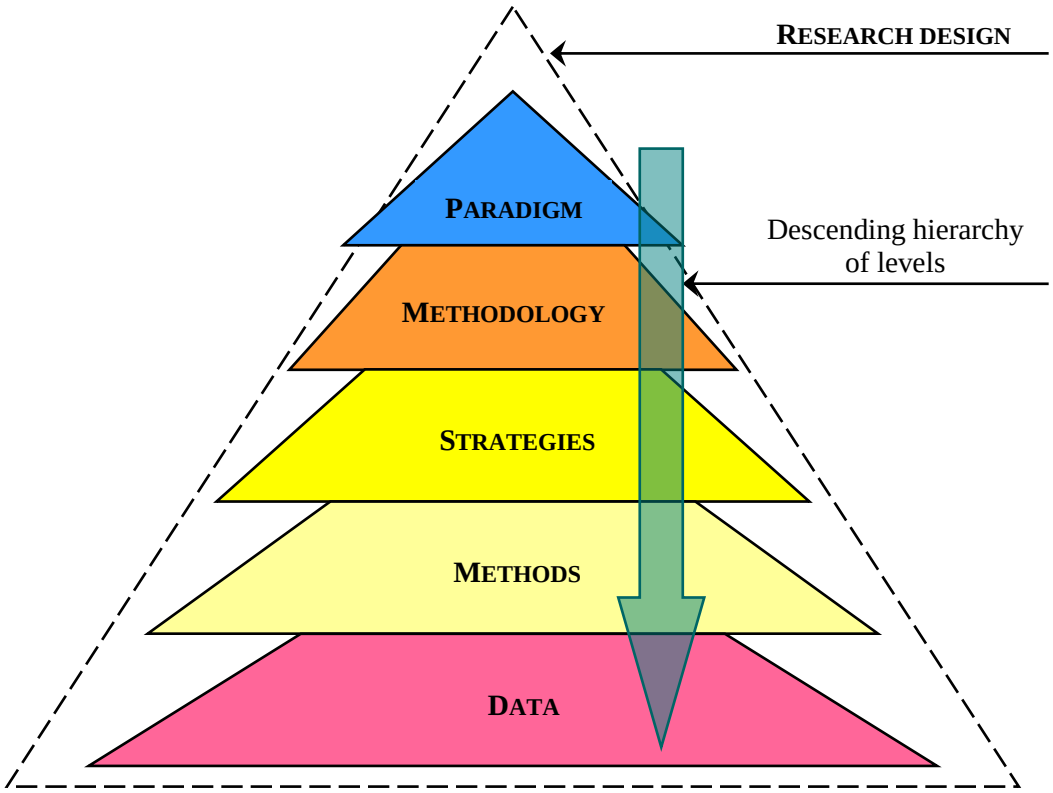


Figure 3. Concept of the research design developed for the purpose of this thesis.

The research design applicable to the investigation is coherent with the suppositions and principles characteristic of qualitative research. Concurrently, a substantial component of the research findings are presented from a quantitative perspective. The methodology of the investigation is rooted in the mixed methods movement, which in turn is closely linked to the paradigm of pragmatism, as shown in the summary of the association between the paradigms of positivism/post-positivism, constructivism and pragmatism, and the three methodological movements proposed by Teddlie and Tashakkori (2009).

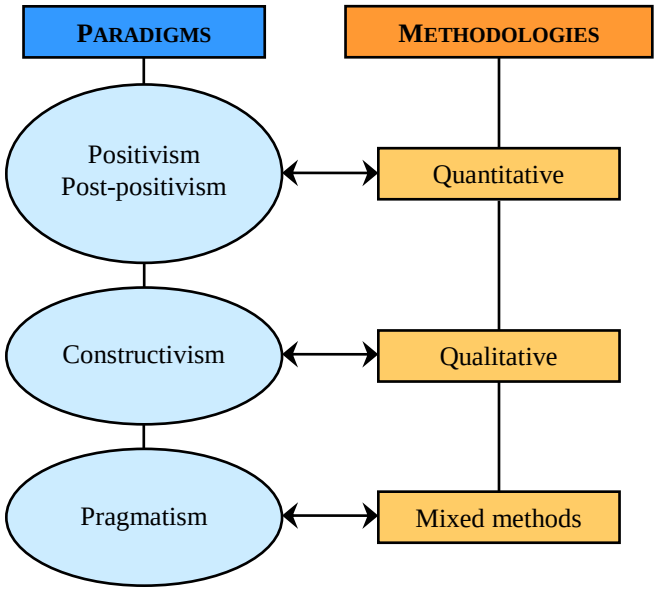


Figure 4. The association between the paradigms of positivism/post-positivism, constructivism and pragmatism, and the three methodological movements proposed by Teddlie and Tashakkori (2009).

The research design is summarised by the framework presented in Figure 5, which corresponds to Figure 3 with regard to the colour coding of the different levels.

The study included a combination of strategies, namely design-based research, naturalistic evaluation of an artefact, and a qualitative case study. Results (data) are presented from a qualitative perspective as descriptive inferences, which include interpretative reasoning, explanations, conclusions and implications. A quantitative perspective is provided in the form of descriptive statistics.

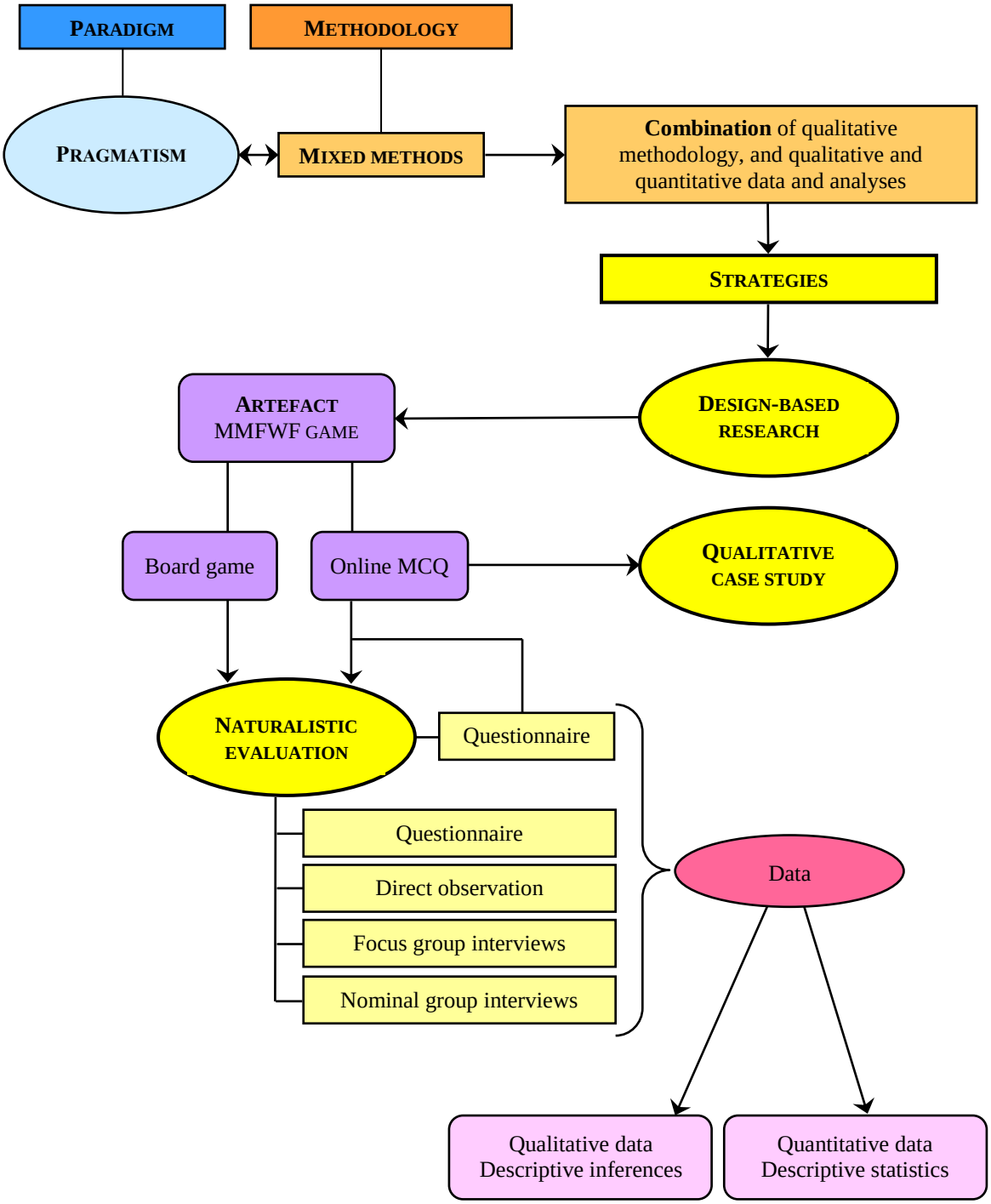


Figure 5. Framework of the research design.

7.3 Mixed methods methodology

Mixed methods research has evolved over the past two decades as an alternative to the dichotomy of quantitative and qualitative approaches to research. Until the late 1980s, quantitative and qualitative research methodologies were mostly regarded as incompatible. This view, based on Kuhn's (1962, cited by Teddlie & Tashakkori, 2009:73) argument that competing paradigms were *incommensurable*, was referred to as the incompatibility thesis. By implication, it was viewed as impossible to directly compare the quantitative and qualitative paradigms with each other, or to clearly communicate between the two.

Howe (1988) strongly disagreed with the view that qualitative and quantitative methods belong to discordant, competitive paradigms, namely interpretivism and positivism, respectively. He appealed for a pragmatic philosophical perspective, arguing that no incompatibility existed between the two methods, neither at practical level nor from an epistemological perspective, and that educational researchers had no valid reason to fear or quit continuing with *what works* (Howe, 1988:10). Teddlie and Tashakkori (2009) give a clear explanation of what they call the three research communities in the social and behavioural sciences. The basic characteristics of these three methodological movements are briefly summarised in Table 5, along with a definition of each of the paradigms within which these methodologies are primarily located.

Table 5. The three methodological movements and their corresponding paradigms as summarised by Teddlie and Tashakkori (2009).

METHODOLOGICAL MOVEMENT	PRIMARY PARADIGM	TYPE OF DATA OF PRINCIPAL INTEREST	DEFINITIONS OF PARADIGMS AND CONCEPTS APPLICABLE TO THE METHODOLOGICAL MOVEMENT
Quantitative	Positivism Post-positivism	Numerical data and analyses	• ***Positivism*** proposes that social research must adopt scientific method and consists of rigorous testing of hypotheses by means of data taking the form of quantitative measurements. • ***Post-positivism*** refers to any paradigm proposed as a substitute of positivism, which may still be bound to a quantitative orientation. Post-positivism allows for (i) the possibility of prediction at the group level and in probabilistic form; (ii) the culture-boundness of research questions, methods and inferences; and (iii) differentiating between social and physical reality.
Qualitative	Constructivism	Narrative data and analyses	• ***Constructivism*** proposes that researchers individually and collectively construct or conceptualise the meaning of the phenomenon under investigation; observation cannot be pure in the sense of totally excluding the interests and values of individuals; investigations must employ empathetic understanding of study participants.
Mixed methods	Pragmatism	Both numerical and narrative data and their analyses	• ***Pragmatism*** is defined as a deconstructive paradigm that strives to demystify and explicate concepts such as "truth" and "reality", and rather concentrates on "what works" as the truth regarding the research question(s) being investigated. The pragmatic paradigm (i) rejects the either/or choices associated with the so-called paradigm wars; (ii) supports the use of mixed methods in research; and (iii) admits that the values of the researcher play an important role in the interpretation of results.

Skerratt (2008:122) asserts that mixed methods are of specific practical value for two types of inquiry, namely (i) when the problem under investigation is multi-faceted and thus necessitates multiple points of view from various disciplines, each with its unique instruments and approaches; and (ii) when the aim is to perform a multi-stage research project, either from an in-depth (individual) to macro- (population) level, or, conversely, from an analysis of trends in a larger population down to the behaviour, attitudes and perceptions of a particular group of individuals. Research in teaching and learning comprises multi-faceted inquiry as it involves diverse problems and issues. Using a combination of tools to investigate these different aspects provides richer data, allowing for a 'thick description' of findings. The inquiry is furthermore regarded as *more exciting* due to the different data types produced by each approach or instrument (Skerratt, 2008:123).

7.3.1 Definition of mixed methods research

In the very first issue of the *Journal of Mixed Methods Research (JMMR)* in 2007, the two editors, Abbas Tashakkori and John Cresswell, broadly define mixed methods as *research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of inquiry* (Tashakkori & Cresswell, 2007:4). In the subsequent issue of *JMMR*, Johnson, Onwuegbuzie and Turner (2007) report their endeavour to compile a summarised definition of mixed methods research by means of content analysis of 19 different definitions proposed by various authors. Based on their analysis of these 19 definitions, they suggest the following general definition for mixed methods research (Johnson et al., 2007:123):

> *Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration… A mixed methods study would involve mixing within a single study; a mixed methods program*

would involve mixing within a program of research and the mixing might occur across a closely related set of studies.

Johnson et al. (2007) further describe mixed methods research as an intellectual and practical synthesis based on qualitative and quantitative research, and refer to it as the third methodological or research paradigm. In addition to recognising the importance of traditional qualitative and quantitative research, *[mixed methods research] offers a powerful third paradigm choice that often will provide the most informative, complete, balanced and useful research results* (Johnson et al., 2007:129).

7.3.2 The philosophical relationship between mixed methods and pragmatism

Pragmatism can be viewed from two different perspectives, namely (i) as a way of thinking about results; and (ii) as a way of evaluating theories. With regard to results, pragmatism is a *straightforward practical way of thinking about things or dealing with problems, concerned with results rather than with theories and principles* (Encarta, 1999:1478). As a way of evaluating theories, pragmatism is described as *a philosophical view that a theory or concept should be evaluated in terms of how it works and its consequences as the standard for action and thought* (Encarta, 1999:1478).

Many versions of pragmatism have been proposed, with different points of emphasis and interpretation. However, says Cherryholmes (1992:13), *I can think of few major disagreements among pragmatists*. Anticipated consequences and results are the compelling force behind all pragmatic research. Pragmatism rejects positivism and empiricism, and also the view that grounded meaning and truth can be established permanently and irreversibly (Cherryholmes, 1992:16). John Dewey made the statement in 1931 that *[p]ragmatism… does not insist upon antecedent phenomena but upon consequent phenomena; not upon the precedents but on the possibilities of action* (Cherryholmes, 1992:13). Pragmatism presents a third choice that permits superordinate ideas accumulated by taking perspectives from both sides of the quantitative and qualitative paradigms debate into consideration (Teddlie & Johnson, 2009:73–74).

When Howe (1988) rejected the point of view that qualitative and quantitative methodologies were incompatible, he proposed the compatibility thesis, using pragmatism as its philosophical foundation. Howe (1988:15) describes pragmatism as follows:

> *After all, much of pragmatic philosophy is deconstructive – an attempt to get philosophers to stop taking concepts such as "truth", "reality" and "conceptual scheme", turning them into superconcepts such as "Truth", "Reality" and "Conceptual Scheme", and generating insoluble pseudo-problems in the process.*

As noted in the definition of pragmatism in Table 5, personal values cannot be left out of the equation in this paradigm. Pragmatists are of the opinion that values play a significant role in drawing conclusions from research findings. However, they see no justification to be overly concerned about it. They choose what they want to study based on what is prominent in their personal value systems (Tashakkori & Teddlie, 2010; Teddlie & Tashakkori, 2009), and then conduct their research on that topic in a way that corresponds to their value system, including units of analysis and variables that they consider are most likely provide intriguing results. Howe (1988) explains that from the pragmatist's point of view, *truth* is a normative concept, and the notion of *truth is what works*, is not regarded as a theory or definition, but a personal attempt to say something interesting and worthwhile about the nature of truth (Howe, 1988:15).

7.4 The qualitative strategies employed in the research

The strategies (sections 7.4.1 to 7.4.3) included in the study design presented here meet the criteria for qualitative research as proposed by Denscombe (1998), in that they may be associated with:

- words as the unit of analysis (versus numbers in quantitative research);
- description (versus analysis in quantitative research);
- a small-scale study (versus large-scale studies in quantitative research);
- a holistic perspective (versus a specific focus in quantitative research);

- researcher involvement (versus researcher detachment in quantitative research); and
- an emergent research design (versus a predetermined research design in quantitative research).

As suggested by Denscombe (1998), qualitative research often involves researchers' own development of designs as their investigations evolve. Denscombe (1998:176) corroborates this viewpoint by stating that *qualitative research is frequently premised on the idea that the theory and the methods will emerge during the course of the research,* which was indeed experienced while doing the research presented here.

It was clear from the onset of the study that the research methodology would employ a combination of various qualitative strategies. On the basis of (i) the production of an artefact (Hjelm, s.a.; Kroes, 2002) involving a tangible creative process; and (ii) being pragmatic, interactive, iterative, flexible, integrative and contextual (Simonson, 2006), the study can be considered to be underpinned primarily by a design-based strategy. With their argument that designers should be aware of the uncertainty associated with design-based research and be prepared to completely redirect the tentative strategy, Juuti and Lavonen (2006) strongly link up with Denscombe's (1998:176) view that in a qualitative investigation, *methods will emerge during the course of the research*. Three qualitative research strategies were combined in this study, including (i) design-based research, (ii) naturalistic evaluation of an artefact, and (iii) a qualitative case study (cf. Figure 5).

The design product – the artefact – required evaluation from different perspectives in order to determine its potential usability in the Infections module of the medical curriculum, thus requiring a qualitative/naturalistic evaluation strategy (Mouton, 2001; Patton, 1990). Based on students' evaluation of the MMFWF board game and their recommendations and critique, the question-and-answer database was converted to multiple-choice questions (MCQs) used in the online version of the game. When the online (e-MMFWF) version was implemented as compulsory directed learning before the second semester test in the Infections module, a qualitative case study strategy was incorporated into the overall design (Stake, 1995; 2000). The case study describes a specific situation – poor performance in the first semester test of

the module – that required an intervention in order to address the problematic nature of the situation.

These three research strategies – design-based research, qualitative (naturalistic) evaluation, and qualitative case study – will be discussed in more detail in the following paragraphs. It will be indicated, where applicable, which research methods were used in each of these strategies, and what type of data (qualitative and/or quantitative) were generated by these methods.

7.4.1 The design-based strategy

Design-based research is an accepted approach to investigating the theoretical and empirical aspects of learning amidst complex educational interventions employed in everyday settings. The viewpoint that important aspects about the nature and conditions of learning can be uncovered by attempting to apply and maintain educational innovation in real-life circumstances, is the fundamental thesis in which design-based research is rooted (Bell, 2004; Ma & Harmon, 2009). Design researchers play an important part when it comes to materialising abstract ideas. When challenged to transform existing norms and customs, design constitutes an essential component of the research context (Hjelm, s.a.). Hjelm (s.a.:1) aptly states that *[t]o communicate knowledge, it needs to take a physical shape, to be designed into an artefact*.

Amiel and Reeves (2008) assert that an elementary objective of design-based research is to develop a stronger connection between educational research and authentic difficulties. Prominence should be given to an iterative process that does not only appraise an innovative product or intervention, but systematically makes an effort to improve the innovation and turn out design principles that can give direction to similar research and development activities. Iterations – or cycles of repetition – are necessary to refine not only hypotheses, but also the innovative product or procedure. Commitment to iterative design, however, is most of the time inadequate and lead to so-called one-shot studies (Amiel & Reeves, 2008; Ma & Harmon, 2009). A potential solution to prevent such a one-shot outcome, is to submit the design artefact

to an action research approach, involving repetitive cycles of implementation, evaluation, interpretation of feedback, improvement of the design, and re-implementation of the improved product – or, as classically proposed by Kember and Kelly (cited by Biggs & Tang, 2007:253), *reflect, plan, act, observe… reflect, plan, act, observe….* Another proposed characteristic of design-based research which is also frequently neglected (Amiel & Reeves, 2008), is the collaboration between the researcher and the practitioner in the form of engaging the practitioner in the design process (Amiel & Reeves, 2008; Ma & Harmon, 2009).

According to Hjelm (s.a.), design can be differentiated into three core meanings, namely design as (i) process; (ii) practice; and (iii) product. Design as process refers to the general, inherent ability to conceive, create and change circumstances or situations, which is a shared characteristic in all humans. The second aspect, the design practice, refers to an activity that will eventually determine the properties and appearance of a physical artefact. Design practitioners are able to solve complex problems, and to visualise and materialise a specific product aimed at an end user. They possess the knowledge to give shape to abstract ideas, find appropriate metaphors, and make artefacts visually acceptable and usable. The design product represents the end result and object of the design process, and refers to the physical form of an artefact (Hjelm, s.a.). Artefacts have a dual nature: they are physical as well as intentional objects simultaneously. Their physical nature refers to the fact that they are man-made constructions that can be used to perform a certain function, whereas their intentional nature refers to its function having meaning only within a context of intentional human action (Kroes, 2002).

With regard to the study presented in this thesis, the MMFWF board game and the online version of the game, e-MMFWF, are the artefacts developed as products of the design-based strategy employed in the research. The development and evaluation of the MMFWF board game cannot strictly be regarded as a 'one-shot' study as proposed by Amiel and Reeves (2008), and Ma & Harmon (2009). A second 'cycle' of game development was undertaken when e-MMFWF was created in response to students' and staff's recommendations that the game could also be useful as an electronic application. The design-based strategy applicable to

the production of the game is described in Part II of the thesis, *Development of the Med Micro Fun With Facts (MMFWF board game and its online version (e-MMFWF).*

7.4.2 The qualitative (naturalistic) evaluation strategy

A qualitative, naturalistic investigation implies that the researcher does not attempt to influence or control the research setting, which then presents a naturally occurring event or programme that has not been manipulated by a predetermined course of action. The purpose of naturalistic research is to gain understanding of a naturally occurring phenomenon within its natural environment (Patton, 1990; Rubin, 1982).

Naturalistic evaluation has been developed from ethnographic methodologies originally proposed by anthropologists, and provides detailed information of individuals, groups, institutions, programmes and products as they occur in their natural context. It concentrates on programme activity rather than intent, and mainly relies on qualitative data and analysis. Information can be identified from several different data sources and methods. The use of various data types and resources enhances the validity of naturalistic methods (Siddiqui, 2006).

When conducting programme or product evaluation, the research questions usually intend to determine (i) whether a programme or product has met its goals and objectives in general – that is, outcomes-based evaluation; and (ii) how the programme or product was put into practice, and how it is functionally operating at the present moment – that is, process-based evaluation (Teddlie & Tashakkori, 2009). A fundamental objective of qualitative evaluation is to describe change following the implementation of an intervention and monitoring the evaluation of the implementation (Owen & Rogers, cited by Henning, 2004).

Education, including medical education, is constantly challenged to implement innovative approaches to curriculum development and teaching and learning processes. Vital information regarding the subsequent use of these innovations and their application to enhance students'

learning experience can be obtained by means of critical assessment of these approaches and techniques (Siddiqui, 2006).

In the research reported here, evaluation of the MMFWF game was performed by submitting the game for assessment by (i) the students who participated in the introduction of the game, and (ii) members of staff involved in the undergraduate medical curriculum. The students' evaluation of the game was done by means of a self-administered, anonymous questionnaire (Appendix B) and semi-structured focus group interviews (Brodigan, 1992; Morgan, 1988) with a representative group of students selected by means of stratified random sampling (Leedy, 1989). Members of staff evaluated the active play process through direct observation (Fromme, Karani & Downing, 2009; Henning, 2004), and their views on the game itself were captured by means of the nominal group technique (Chapple & Murphy, 1996; Lloyd-Jones, Fowell & Bligh, 1999). The questionnaire, direct observation and nominal group interviews yielded quantitative data, while qualitative data were generated by means of the focus group interviews.

Findings on the students' evaluation of the MMFWF board game are described in Part III, Article I *(An innovative approach to the management of knowledge overload in medical microbiology)*, while Article III *[(Evaluation of a microbiology and infectious diseases board game by medical teaching staff using direct observation and the nominal group technique (NGT)]* describes the evaluation of the board game by members of staff.

7.4.3 The qualitative case study strategy

The term *case study* directs attention to the question of what specifically can be learnt from a single case. *As a form of research, case study is defined by interest in individual cases, not by the methods of enquiry used* (Stake 2000:435). From Yin's (2003:13) perspective, a case study is *an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.*

Case study methods originated from social anthropology and are based on the principles of naturalistic inquiry (Payne, Field, Rolls, Hawker & Kerr, 2007). Two major approaches with regard to case study methodology have been developed by Stake (1995) and Yin (2003), respectively. In principle, both approaches endeavour to ascertain that the topic of interest is thoroughly investigated, and that the fundamental nature of the phenomenon is uncovered (Baxter & Jack, 2008).

A case study may have many different attributes: it may be simple or complex; a single individual or a group of individuals in a specific setting or society; an incident or an intervention. The time spent on studying a particular case or a group of similar cases, may vary in duration (Stake, 2000). A case may involve, for example, the occurrence of a phenomenon on a specific time in a demarcated setting, or the outcomes of the implementation of a programme or product in various parallel communities over a period extending from months to sometimes years. While being engaged in a case study, all attention and focus will be converged on that particular case, regardless of its distinctive characteristics (Stake, 2000).

Mark (cited by Fouché, 2002b) describes three different types of cases studies, each with its own purpose. He distinguishes between (i) intrinsic; (ii) instrumental; and (iii) collective case studies. An intrinsic case study – as applicable to the research reported in this thesis – is exclusively focused on gaining better insight into the individual case, and its purpose is merely to describe the case being studied, and not to understand a broad social issue. An instrumental case study is used to further develop and explain a specific theory, or to gain understanding of a social issue; it serves the purpose of facilitating the researcher in obtaining knowledge about the social issue. The aim of a collective case study is to promote the researcher's understanding of a social issue or population being investigated, while concern with the individual case is secondary to the researcher's interest in a group of cases. In a collective case study, cases are selected in order to draw comparisons between cases, so that theories can be extended and validated (Fouché, 2002b).

Three key components of the case study strategy were addressed when the once-off use of the electronic version of MMFWF (e-MMFWF) and students' evaluation thereof were conducted,

in the sense that it was (i) an intervention that occurred (ii) in a real-life (natural) situation, (iii) in a demarcated setting. To explain briefly, in 2004, the then second-year students who were doing the Infections module during Semester 4, played e-MMFWF as a compulsory directed learning activity, after most of them had performed poorly in the first assessment of the module. Before the second assessment opportunity, an exposition of the marks obtained in Test I was presented to the students as reason for the implementation of the compulsory directed learning. Following Test II, the e-MMFWF game was evaluated by this group of students by means of a self-administered, anonymous questionnaire (Appendix C). Data generated by means of the questionnaire were of a quantitative nature.

The intervention was represented by the implementation of e-MMFWF as compulsory directed learning, which occurred in a real-life situation as students used it as part of their preparation for an upcoming test in the Infections module. The setting was demarcated as the intervention occurred with a specific group of students at a specific point in time, due to circumstances unique to their situation at that given time. Article V *(A case study on the use of an online multiple-choice game to improve students' academic performance in the Infections module of an undergraduate medical programme)* in Part III of the thesis describes the methods and findings of the case study strategy.

7.5 A trio of validity partners[6] in qualitative research

Kvale (cited by Henning, 2004:146–147) proposed the concept of *the trinity of reliability, validity and generalization*, also referred to as the *scientific holy trinity* of the natural sciences. These three concepts were transferred into the early discourse of the social sciences, although pioneers of qualitative research, such as Lincoln and Guba, expressed their reservations regarding the terms and what they represented (Henning, 2004). Kvale later agreed to the *ordinary language terms* proposed by Lincoln and Guba to discuss the truth values of their findings, namely *trustworthiness, credibility, dependability and confirmability* (Henning, 2004:147).

[6] Borrowed from Henning (2004:151).

Henning (2004:147) describes her struggle with issues and concepts related to *the use of trinity jargon*, and firmly states that she has come to a place where her viewpoint can be condensed to *precision is all*. She continues by proposing *good craftsmanship, honest communication and action* as reasons for rating an investigation as *good scholarship* (Henning, 2004:147). She concludes with the argument that the research community may be able to determine and assess the merit of research when the validity of the research is founded on (i) craftsmanship with precision, care and accountability; (ii) continuous open communication during the research process and revealing the process to the scrutiny of the research society; and (iii) truthful, ethical soundness (Henning, 2004). From a similar perspective, the validity and reliability of qualitative data, according to Patton (1990), is to a considerable extent determined by the methodological competence, sensitivity and integrity of the researcher.

Triangulation, according to Mouton and Marais (1990), refers to the use of a combination of different methods of data collection, with the primary objective to increase the reliability of observation. Several types of triangulation have been identified, amongst others triangulation of measures and observers, of which triangulation of measures is most commonly described. De Vos (2002:341) explains triangulation of measures as taking *multiple measures of the same phenomenon*, since it creates a greater possibility that researchers will see all aspects of the phenomenon by measuring it in more than one way. With regard to observation, multiple observers instead of only one individual performing the observation will obtain complementary perspectives. Similarly, combining data produced by different individual observers, will yield a more complete view on the issue investigated (De Vos, 2002). One of the most important strengths of using triangulation in qualitative research, as proposed by Jick (cited by De Vos, 2002), is that it enhances the researcher's confidence in the results.

Different methods were used in this research to obtain feedback from students regarding the MMFWF game and its influence on their perception of medical microbiology, namely three questionnaire surveys (one before and one after the board game was played, respectively; and one after the online version of the game was played), and semi-structured focus group interviews. To obtain the opinion of academic staff members, direct observation of the play

process and the nominal group technique were used. This combination of methods represents triangulation, supporting the reliability of the findings.

8 CONTEXT AND DEMARCATION OF THE STUDY

The research was conducted in the School of Medicine, Faculty of Health Sciences at the UFS, with specific focus on the Infections module. After the MMFWF board game had been designed and developed, it was introduced to and evaluated by medical students and members of staff in the School of Medicine.

Medical students who had completed the Infections module in November 2002 (in other words at the end of Semester 4 of the curriculum) were involved in the evaluation of the MMFWF board game at the beginning of their third academic year (Semester 5), that is, in January 2003. These students were included in the research as they would presumably be able to evaluate the game from a retrospective point of view. Having completed the Infections module, they would be in a position of experience that would enable them to consider and indicate how the MMFWF game could potentially have assisted them in mastering the subject content of the module. The fact that the students had already completed the module and would most likely not experience pressure or emotional discomfort during the play process, was also considered to be an advantage during the evaluation process (Struwig et al., 2005).

The play process was also evaluated by invited members of staff in the School of Medicine, by means of a direct observation procedure (Cohen, Manion & Morrison, 2000; Flick, 2006; Henning, 2004). The nominal group technique (NGT) (Chapple & Murphy, 1996; Delbecq & Van de Ven, 1971; Lloyd-Jones et al., 1999) was used to involve managerial and lecturing members of staff from both the pre-clinical (phases I and II) and clinical (phase III) components of the curriculum to evaluate the MMFWF board game.

The primary focus was directed at the effect of the board game on students' perception of, and attitude towards medical microbiology as a basic pre-clinical science, and its potential application as a learning modality and group activity in the Infections module.

With regard to the online version of the game, the second-year medical students of 2004 were required to play e-MMFWF as a compulsory directed learning activity in preparation for their second semester test in the Infections module, after they had performed poorly in Test I. Their opinion on e-MMFWF as a potential learning tool in medical microbiology, as well as their perceived contribution of the game to their improved test marks, were obtained by means of a questionnaire survey.

9 DEFINITION AND EXPLANATION OF KEY CONCEPTS

In order to avoid confusion, the key concepts used in this thesis that need to be defined and explained, are listed below.

9.1 Terms regarding the Infections module (MJR224)

Module MJR224 and Infections module

Module MJR224 refers to the Infections module (the latter is predominantly used in the thesis) at the time of the study presented to second-year medical students as part of the undergraduate MBChB curriculum in the School of Medicine, Faculty of Health Sciences, UFS. The module covered what has been identified by the module team (a consultant pathologist, registrars and scientists in the Department of Medical Microbiology) as core knowledge in basic medical microbiology and infectious diseases. The study material comprised (i) clinically relevant pathogenic microorganisms (bacteria, viruses, fungi and parasites); (ii) the diseases caused by these pathogens with the inclusion of the patient's specific history, symptomatology and special contributing factors where necessary; (iii) the clinical and laboratory diagnosis of infections; (iv) the relevant treatment required to manage infections; (v); problems encountered with the treatment of infections due to acquired and inherent resistance to antimicrobial agents; and (vi) prevention of infections by means of immunisation programmes and infection control precautionary measures.

Core knowledge

Harden (2001a:49) explains the concept of a core curriculum as *an important strategy in the battle against information overload*, and defines it as *essential or key aspects of a subject or a discipline* (Harden, 2001a:41). The topics included in the Infections module and regarded by the module team as core knowledge, were nevertheless experienced by students as an overwhelming volume of work. Despite being presented as core knowledge, the Infections module could thus be regarded as having an extensive scope due to the nature of medical microbiology and infectious diseases as a discipline.

9.2 Terms regarding games and play

Educational game

Compiled from different authors' opinions, Akl et al. (2009:2) present what could be regarded as a collective definition of an educational game, which is:

> *…. an instructional method requiring the learner to participate in a competitive activity; .... is a type of experiential learning where the learner engages in some activity, looks back at the activity critically, abstracts some useful insight from the analysis and puts the results to work; includes a variety of activities including teaching, training, practicing skills, long-range planning, research, operational analysis, entertainment, and theory building; in a risk-free, active environment; [while learners] benefit both from participating in the game and from discussions that follow.*

MMFWF was produced with the explicit objective to serve as a potential learning modality in the Infections module. Based on this description, the MMFWF game fulfils the criteria to be classified as an educational game focusing on medical microbiology, with medical students as the intended user audience.

Play

In this thesis, play is regarded exclusively as pertaining to the modern rhetorics of play as progress and power (Sutton-Smith, 1997), and play as cognitive development (Piaget and Vygotsky, cited by Stagnitti (2004). When play was incorporated into an educational setting – undergraduate medical training in this particular study – it was done with the specific aim to explore it as an alternative approach to learning.

10 OUTLINE OF THE THESIS

Subsequent to **Part I**, *General Perspective and Orientation,* **Part II** of the thesis is titled *Development of the Med Micro Fun With Facts (MMFWF) board game and its online version (e-MMFWF),* and explains the background to the origin of the concept and the author's personal motivation to engage in this research. Part II further describes the process of manually manufacturing the different components of the board game, the rules of the game, its conversion to the online version, e-MMFWF, and the categorisation of MMFWF based on (i) the mechanism of the game; and (ii) the complexity of the underlying concept of learning by experience (Bochennek et al., 2007).

Part III consists of five articles, of which Articles I and II have already been published in peer-reviewed journals. The articles included in the thesis are:

- **ARTICLE I**

  Struwig MC, Beylefeld AA & Hugo AP. (2005). An innovative approach to the management of knowledge overload in medical microbiology. *South African Journal of Higher Education* 19 (Special Issue): 1473–1485.

- **ARTICLE II**

  Beylefeld AA & Struwig MC. (2007). A gaming approach to learning medical microbiology: students' experience of flow. *Medical Teacher* 29: 933–940.

- **ARTICLE III**

  Evaluation of a microbiology and infectious diseases board game by medical teaching staff using direct observation and the nominal group technique (NGT).

- **ARTICLE IV**

  The comorbidity of content overload, poor motivation, surface learning, suboptimal retention of knowledge, and a Zeigarnik-like effect in undergraduate medical microbiology: what is the prognosis?

- **ARTICLE V**

  A case study on the use of an online multiple-choice game to improve students' academic performance in the Infections module of an undergraduate medical programme.

Part IV represents the researcher's final reflection on the research process and findings, where she confronts herself with relevant questions pertaining to (i) reaching her intended objectives; (ii) the influence of the MMFWF game on students' perception of medical microbiology; (iii) the future of the game; and (iv) whether the research made a meaningful contribution to the pedagogy of microbiology and infectious diseases for medical students. Recommendations with regard to the potential practical application of the MMFWF game are also proposed in Part IV.

References cited in Parts I, II and IV of the thesis are listed at the back of the thesis in the Bibliography. The five articles included in Part III of the thesis each has its own list of references, of which some may also occur in the Bibliography.

PART II

DEVELOPMENT OF THE MED MICRO FUN WITH FACTS (MMFWF) BOARD GAME AND ITS ONLINE VERSION (E-MMFWF)

1 INTRODUCTION

Due to the personal disposition of the game design and development process, it is brought to the reader's attention that this section of the thesis will predominantly be presented in the first person.

The design and principles of the Med Micro Fun With Facts (MMFWF) board game are based on the concept of the popular, general knowledge quiz game, Trivial Pursuit™, which took the world by storm in the early 1980s. At the time, I had read about the game in the media and desperately wanted a set of my own. I received my first set of Trivial Pursuit™ in 1985 when I was still an undergraduate BSc student. It was a welcome and sincerely appreciated gift from a family member – actually given as a reward for doing well in a microbiology semester test.

Trivial Pursuit™ was invented in December 1979 by two friends, Scott Abbott, a sports journalist for the Canadian Press, and Chris Haney, a photo editor at the *Montreal Gazette*. They later involved two more business partners and continued with the development of the game, which was trademark-registered and became commercially available in 1981 (Bellis, s.a.; Tweten, 2008). Its popularity peaked in 1984 when more than 15 million sets of the game were sold around the world (Tweten, 2008).

Just over ten years after its release, Trivial Pursuit™ was entered into the *Games Hall of Fame* by *Games Magazine* (Bellis, s.a.). Since then, numerous special editions, for example, *Star Wars* and *Lord of the Rings*, and versions focusing primarily on specific topics such as sports or popular television series, were developed. It is now also available in digital format (Tweten, 2008), and can be played on the internet, mobile phones and other electronic game devices such as Sony Corporation's PlayStation® and Microsoft's Xbox®.

In 2008, the American games company, Hasbro Incorporated, paid the inventors 80 million US dollars for exclusive rights to the game license, and now owns the intellectual rights. Following the transaction, Brian Goldner, the chief operating officer of Hasbro Inc., stated that the company *... can build Trivial Pursuit™ beyond traditional venues and capitalize on new opportunities in entertainment, publishing, promotions and digital arenas* (Tweten, 2008: s.p.). This statement supports an undeniably strong prediction that the game, nowadays available in many forms and formats due to modern-day technology, will keep hold of its popularity with Trivial Pursuit™ enthusiasts of all ages.

Apart from the pure enjoyment of playing the game, Trivial Pursuit™ instigated the emergence of a new level of curiosity in me. When I did not know the answer to an interesting question, or when the question was on an appealing topic about which I was poorly informed or totally lacking knowledge, I could not wait to get to an encyclopedia, dictionary or textbook to read more about that specific issue. Not only did I want to accumulate information for the next session of play with an extremely competitive friend; I simply could not tolerate the thought of 'not knowing', and developed a craving to be informed as widely as possible. It should be mentioned at this point that in 1985, internet-based search engines such as Google did not exist. In fact, the founders of Google, Larry Page and Sergey Brin, were both only eight years of age (Notable Biographies, s.a.) when Trivial Pursuit™ made its epic entrance in 1981 (Bellis, s.a.; Tweten, 2008). Books were the primary source of information.

Of course not all new information acquired through playing Trivial Pursuit™ was processed, integrated into existing schemata and neatly filed into my long-term memory. And yes, definitely not all the fascinating new facts were incorporated into a practically applicable, interconnected and useful context. It cannot be denied that more often than not, the allure of that newly acquired knowledge was short-lived and the details eventually forgotten as a result of not purposefully being constructed into a meaningful system. Nevertheless, quite often, what appeared to be useless information – initially concealed very deep in the folders of consciousness many years ago, but readily available when required – could instantaneously be retrieved in the most unexpected situations and circumstances. This vaguely understood autonomous ability is one of the mysteries and miracles of the human mind. For me personally, Trivial Pursuit™ was an exercise in expanding and challenging not only my general knowledge, but also my memory.

From the very first time of playing Trivial Pursuit™ with a friend equally infatuated with this new game, the idea of developing a microbiology board game fashioned on the same model, started to emerge in my mind. The muse became more and more unrelenting as I played the game on a very frequent basis over the years. While doing my Master's degree (MMedSc) in medical microbiology later on, and in particular when I became involved in teaching the subject to undergraduate medical students, what originally surfaced as a fleeting thought, steadily intensified into a matter of burning necessity.

The use of quiz-type games is not uncommon in educational settings, and games are regarded as easy to invent and capable of imitating assessment situations. Games to master different medical topics (cf. Part I, sections 6.7.1 and 6.7.2) have been developed over the past number of years (Bochennek, Wittekindt, Zimmermann & Klingebiel, 2007). Several reports on the successful implementation of games covering various fields of medicine have been published in the literature, for example, *Non-Trivial Pursuit of Physiology* (Zakaryan, Bliss & Sarvazyan, 2005), the *T- and B-Lymphocyte Self-Tolerance Game* (Eckert, Da Rosa, Busnello, Melchior, Masiero & Scroferneker, 2004), and the *Pediatric Board Game* (Ogershok & Cottrell, 2004).

Learning through doing – which occurs during activities such as playing an educational game – offers an alternative to lectures as the primary mode of communicating knowledge. The student becomes part of the processing of information when actively engaged in ventures such as playing a game, providing him/her with the opportunity to master subject content through play as a structured learning experience (Allery, 2004). With regard to games as an experiential learning method, Allery (2004:504) asserted that *learning results from playing the game (i.e. interactions and behaviours exhibited) and not from the academic content or specialist subject matter*.

2 DESIGN AND DEVELOPMENT OF THE MMFWF BOARD GAME

The MMFWF board game consists of the following components:

- a 50 cm x 50 cm board (Exhibit 1) with squares and triangles in seven different colours corresponding to the colours representing each of the question-and-answer categories; Exhibit 2 highlights the difference in appearance between the MMFWF and Trivial Pursuit™ game boards;

- a set of 100 cards (19.5 cm x 12.5 cm), each containing one question and answer from the different categories, thus seven questions and answers per card [Exhibits 3(a) and (b) represent an example of a question-and-answer card];

- four additional cards containing (i) the rules of the game; (ii) an example of how the score card (Exhibit 4) can be used; (iii) the complete reference for each visual image used in the set of cards; and (iv) a quick guide to the colour-coded categories;

- score cards that can be used by participants to monitor their progress from one playing opportunity to the next;

- six play tokens called *sticks*, 36 reward tokens called *doughnuts* (six each for the six different colours of the microbiology categories), and a dice (see Exhibit 5).

2.1 Design of the board

A rough drawing of the MMFWF board (Exhibit 1) was initially made and given to an artist to prepare a refined version of the board, which was required for a poster presentation at an international Health Professions Education congress (Struwig, Janse van Rensburg & Nel, 2002). This refined drawing was then used by a graphic designer as a template for a computer design of the board, using CorelDRAW version 10 (Corel Corporation Ltd., Ottawa). Five copies of the board to be used in the introduction of the game to medical students, were printed and laminated to promote durability.

The seven categories included in the MMFWF board game are:

- bacteriology (blue);
- virology (green);
- mycology (yellow);
- parasitology (red);
- diagnosis of infections (brown);
- treatment of infections (pink); and
- general medicine (grey).

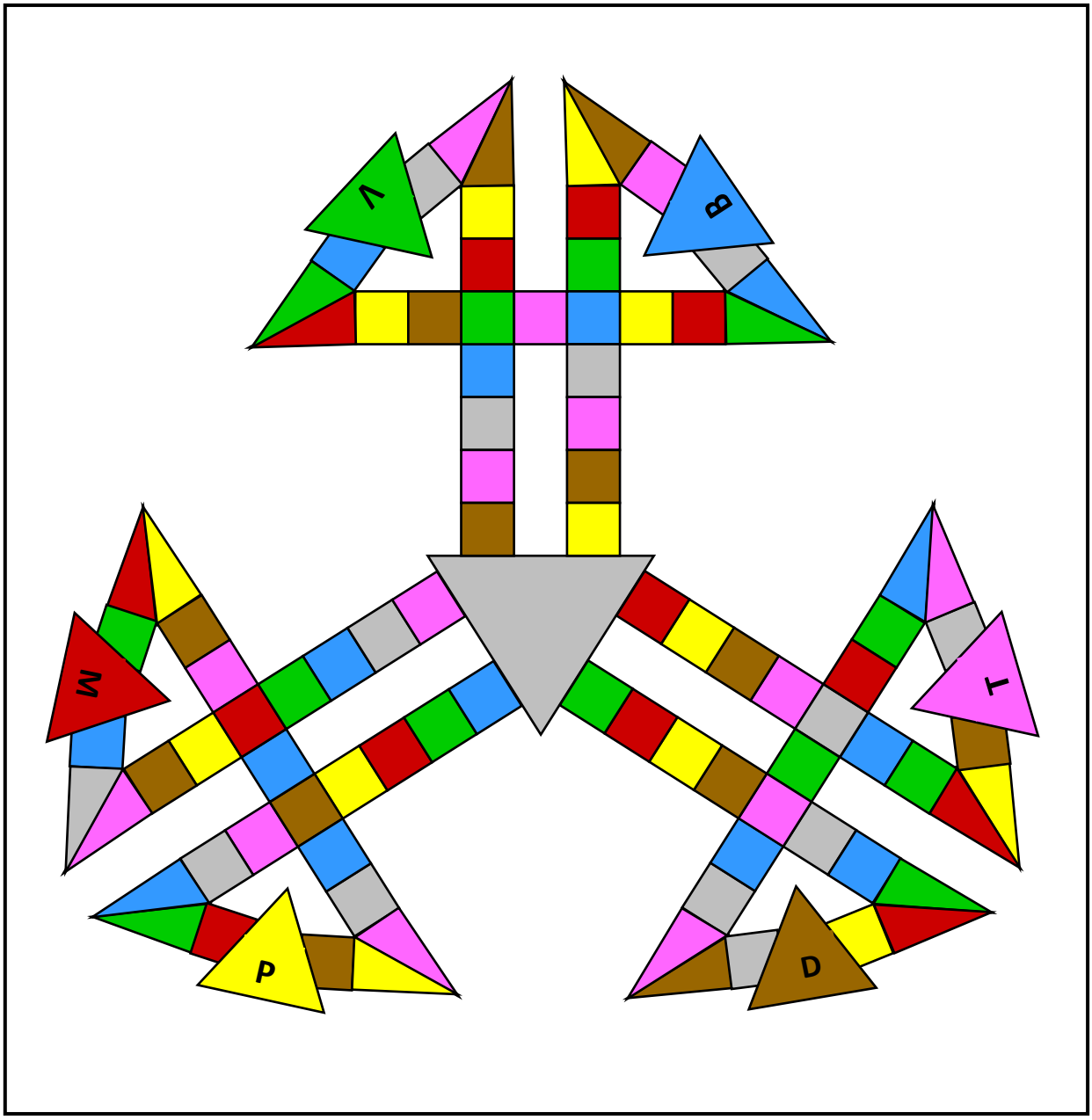


Exhibit 1. The MMFWF game board (scale approximately 1:3.2). The reward triangles are indicated by B – bacteriology; V – virology; M – mycology; P – parasitology; D – diagnosis; T – treatment.

The board consists of the central starting triangle, 93 regular question squares and triangles (14 each blue/bacteriology and pink/treatment, and 13 each green/ virology, red/mycology, yellow/parasitology, brown/diagnosis, and grey/general medicine), and six reward triangles, one for each of the medical microbiology categories. The six reward tokens (doughnuts) can only be scored when a question is answered correctly on the corresponding reward triangle of each category.

Exhibit 2 displays a comparison between the Trivial Pursuit™ and MMFWF game boards in order to highlight the unique appearance of the MMFWF board conceived by the researcher, while showing the conceptual similarities between the two games.

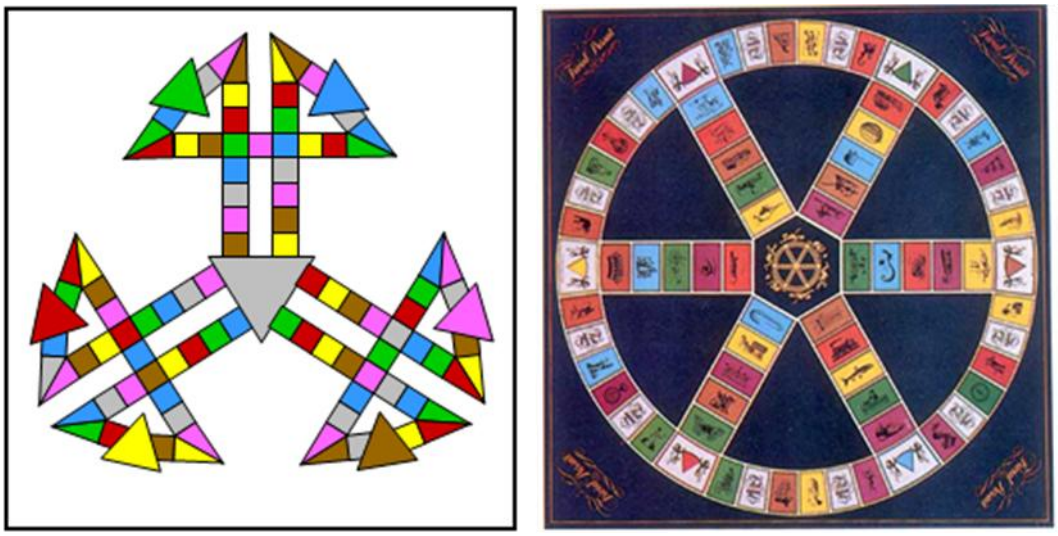


Exhibit 2. Comparison of the board layout of MMFWF (left) and Trivial Pursuit™ (right)[1].

2.2 Design of the question-and-answer cards

Apart from the study notes provided to second-year medical students for the Infections module, numerous textbooks were consulted to ensure the production of a substantial databank of questions and answers. The major sources used in collecting the questions and answers as well as the images, photographs and diagrammes used as supplementary material included in the game, are listed in Appendix D. A number of questions was also

[1] Image of Trivial Pursuit™ board retrieved from http://www.centralconnector.com/GAMES/trivialpursuit1981.html (Accessed 11 January 2011).

obtained from the study material compiled by lecturers in the Department of Medical Microbiology for the Infections module. This module, which was presented in the second semester of the second academic year (semester 4 of the curriculum) at the time of the study, consisted of 14 three-hour sessions. The topics covered during each hour of these sessions are listed in Appendix E.

Each question-and-answer card contains one question and answer from each of the seven categories listed above. A total of 700 questions and answers are included in the set of cards, that is, 100 in each category. The different categories are indicated by coloured squares containing the first letter of the particular category (namely B for bacteriology, V for virology, M for mycology, and so forth) positioned to the left of the questions on the card [Exhibit 3 (a)]. A category on general medicine was included to prevent the potential risk of feeling overwhelmed or becoming bored by the numerous medical microbiology facts.

Seventeen percent (17%; 120/700) of the questions, namely 16 bacteriology; 20 virology; 19 mycology; 25 parasitology; 24 diagnosis; 4 treatment; and 12 general medicine, are supplemented with visual material in the form of either a photographic or graphic image. Questions containing visual material – either a photograph or a graphic image – are marked with *VBOC* (view back of card) printed in red (see Exhibit (b)]. Similar to most biological sciences, medical microbiology has a strong visual component. Resembling the combination of theory and its corresponding visual component found side-by-side in a colour atlas of medical microbiology and infectious diseases, the purpose of the visual material is primarily to provide the student with additional information; for example, certain characteristics or diagnostic features of a particular clinical condition, structures that are typical of specific microorganisms, or the appearance of a positive laboratory result [Exhibit 3 (b)].

B

Q: **VBOC: Name two functions of pili in bacteria.**
A: Adhesion; exchange of genetic material (conjugation)

V

Q: **To which two virus families do hepatitis A and B viruses belong, respectively?**
A: A = picornavirus; B = hepadnavirus

M

Q: **What type of infection is caused by *Chrysosporium parvum?***
A: Respiratory infections (infection remains confined to the lungs)

P

Q: **Name three types of infections caused by *Leishmania* species.**
A: Cutaneous, mucocutaneous and visceral (kala-azar) leishmaniasis

D

Q: **VBOC: Which clinically important bacteria can be distinguished by means of the coagulase test?**
A: *Staphylococcus aureus* (coagulase positive) and other staphylococcal species, e.g. *S. epidermidis* (coagulase negative)

T

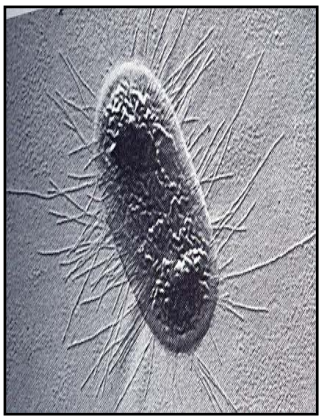
Q: **What is the antibacterial activity of chloramphenicol?**
A: Inhibition of protein synthesis

G

Q: **VBOC: What is the abnormal protrusion of the eyeball, which is most commonly seen in hyperthyroidism, called?**
A: Exophthalmos

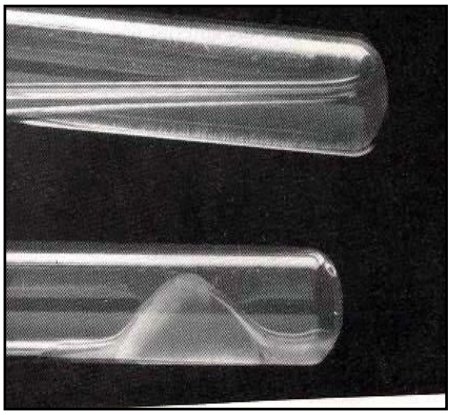
Exhibit 3 (a). Example of the front of a question-and-answer card. **VBOC** = view back of card.

VBOC 13



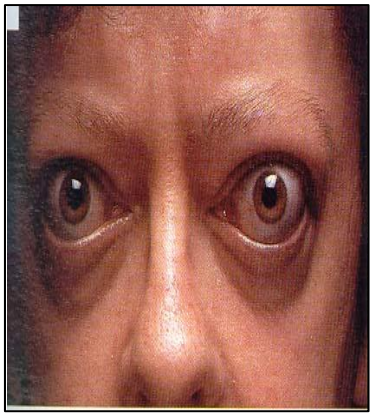
Bacterial pili

VBOC 14



Tube coagulase test

VBOC 15



Hyperthyroidism

Exhibit 3 (b). The back of the corresponding question-and-answer card shown in Exhibit 3 (a), displaying photographic images supplementary to the questions marked **VBOC** (view back of card).

After the questions and answers had been compiled, they were graded as either basic or advanced with regard to their level of difficulty for medical students. The grading of questions was done in collaboration with an experienced subject specialist, trained and qualified in clinical pathology, medical microbiology and virology, who was also involved in teaching in the undergraduate (MBChB) as well as postgraduate [MMed (Microbiology) and MMed (Virology)] curricula at the time. The number of questions per category graded as basic and advanced are listed in Table 1. Based on his personal knowledge and experience, three questions were graded by the subject specialist as irrelevant, including (i) two organisms in the mycology category that he has 'not heard of before'; and (ii) a laboratory test in the diagnosis category that to his opinion 'has no practical value' (personal communication). Due to the small number of questions rated as irrelevant, replacing these three questions was not considered at the time of producing the game.

Table 1. Grading of questions in the MMFWF board game regarding their level of difficulty.

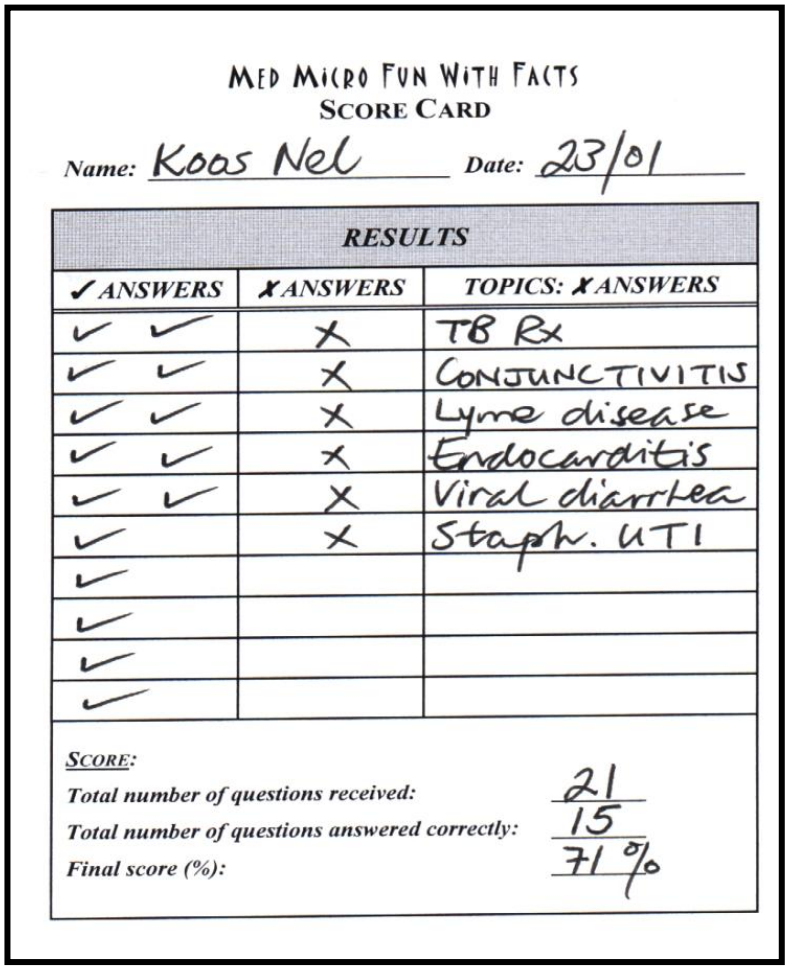
Category (n=100 per category)	**Number of questions regarded as:**		
	Basic	**Advanced**	**Irrelevant**
Bacteriology	61	39	0
Virology	56	44	0
Mycology	54	44	2
Parasitology	57	43	0
Diagnosis of infections	46	53	1
Treatment of infections	60	40	0
General medicine	58	42	0
Total (n=700)	**392 (56.0%)**	**305 (43.6%)**	**3 (0.4%)**

2.3 Design of the score card

The score card (Exhibit 4) is a unique feature of the MMFWF game. A similar score-keeping instrument is not part of the original concept of Trivial Pursuit™. Including a score card as part of the game provides students with an easily managed method of keeping track of their own performance during each playing opportunity. Correct as well as incorrect answers are checked on the score card, while space is provided to list keywords of topics that could not be answered or were answered incorrectly. The student may then,

after completion of the game, revisit his/her study material or textbooks to find the information on the questions answered incorrectly.

The student can also keep score by calculating the percentage of correct answers to record his/her performance over a period of time. The score card may serve as a motivational tool for students (i) to prepare for future games by reading through their study material and/or textbooks; and (ii) to revise the work covered by questions that could not be answered correctly during the game.



MED MICRO FUN WITH FACTS
SCORE CARD

Name: Koos Nel Date: 23/01

RESULTS		
✓ ANSWERS	✗ ANSWERS	TOPICS: ✗ ANSWERS
✓ ✓	X	TB Rx
✓ ✓	X	CONJUNCTIVITIS
✓ ✓	X	Lyme disease
✓ ✓	X	Endocarditis
✓ ✓	X	Viral diarrhea
✓	X	Staph. UTI
✓		
✓		
✓		
✓		

SCORE:
Total number of questions received: 21
Total number of questions answered correctly: 15
Final score (%): 71 %

Exhibit 4. An example of the MMFWF score card.

2.4 Design and manufacturing of the play and reward tokens

The play and reward tokens were designed by the researcher and manufactured manually with the assistance of an artist skilled in woodcraft. The tokens were made from Supawood on a bench press drill using a circular drill blade, and painted with Spectra Spray rapid

drying spray paint in the six colours of the different microbiology categories, namely blue (Azure Blue), green (Brilliant Green), red (Signal Red), yellow (Sunshine Yellow), brown (Golden Brown) and pink (Pink). No play or reward tokens were painted gray, the colour of the general medicine category, since this category was included mainly to introduce interesting facts of general medicine outside the field of medical microbiology. Reward tokens can only be scored in the medical microbiology categories. The play and reward tokens are portrayed in Exhibit 5.

Exhibit 5. Play and reward tokens (sticks and doughnuts) used in the MMFWF board game.

2.5 Broad description of the rules of the game

The rules for MMFWF are similar to those applicable to Trivial Pursuit™. However, less emphasis is placed on winning the game and more attention is given to playing MMFWF as a learning opportunity. Playing the game thus serves as an interactive, informal way to exchange medical microbiology knowledge with peers.

2.5.1 Objective of the game

Although a session of playing the game will have an ultimate winner – that is, the first player (or team of players) to achieve a full token containing reward doughnuts for all six medical microbiology categories – the main objective is to allow each participant to primarily assess his/her own knowledge in the field of medical microbiology. Each participant (or team of participants) completes a score card on which the total number of questions received per session as well as the number of questions answered correctly, are indicated. In that way, students will be able to keep track of their personal progress by comparing their performance with previous sessions of play.

It must be emphasised that the winner might just as well be regarded as the player with the highest percentage of correctly answered questions, or the player who has shown the greatest improvement in providing correct answers since the previous session of play. It is clear, therefore, that finishing first does not necessarily have to be the only criterion by which a winner is declared. It should be kept in mind that the main objective of this method of interactive learning is not only to improve students' knowledge in the field, but also to create enthusiasm towards and a positive perception of the subject to such an extent that spontaneous lifelong learning in the field will be pursued, and furthermore, to provide a stress-free, non-threatening environment within which students can expand their factual knowledge of medical microbiology as a basic science.

In the rules included in the set of cards used by the students during play, it is additionally stated that the aim of the game is to emphasise (i) the possibility of learning while enjoyment is experienced; (ii) that learning through play can be meaningful and rewarding; and (iii) that despite various difficulties, medical microbiology is an exciting field of study. It is also conveyed to the students that there are basically no winners or losers; that everyone is a winner because all players obtain new knowledge during the process of play.

2.5.2 Starting and playing the game

Each player/team selects a token in the color of his/their choice and receives six reward doughnuts, one in each of the six category colors. All players take a turn to roll the dice, with the player rolling the highest number moving first. The player/team having the first

turn rolls the dice again and, beginning from the central starting triangle, moves his/her/their token the indicated number of spaces in any chosen direction. The player is then asked a question from one of the seven categories, depending on the color of the space on which he/she has landed. Since the central starting triangle is coloured grey, it is regarded as a regular space during the game. When a participant/team lands on it in the process of crossing the board, a question from the general medicine category has to be answered.

The question next to the corresponding colour square on the question-and-answer card, is asked by one of the opponents. When the question is marked with *VBOC* (view back of card), it indicates that the question is supplemented with a visual image on the back of the card, representing a structural component of a particular microorganism or a clinical feature/sign, depending on the category and/or question. The player/team will then first have to examine the photograph or graphic image in order to give an appropriate answer.

If the player/team answers the question correctly, his/her turn continues with another roll of the dice. If the player answers incorrectly, the turn passes to the left (clockwise). A move may include a change of direction with each roll of the dice or at an intersection, although backtracking (making a 180° turn-around during a move) is not permitted. A player must always move the number of spaces indicated on the dice. After a question has been answered, the card is put at the bottom of the team's pile.

When a question is answered correctly when a player's/team's token is standing on a reward triangle, the appropriate reward token (doughnut) of the corresponding colour is placed on the stick. If the question is answered incorrectly, the player must leave the reward triangle on the next turn and can later re-enter it to attempt another question to receive the reward doughnut. Any number of tokens may occupy the same space.

Participants can play individually against one another or in teams consisting of no more than four members. In this particular setting, students preferred to play in pairs, and no group consisted of more than six students, that is, three teams of two students each. The students playing as a team divide the pack of cards between themselves before they start playing the game. The division of cards is done on the students' own initiative. For example, if four students play together as two teams with two members each, they either

divide the cards among the four of them, or between the two teams. They also decide beforehand who would present the questions to the opposing team, or whether members of the team would take turns to ask questions to the opponents.

Exhibit 6 shows two groups of medical students involved in the process of playing the MMFWF board game.

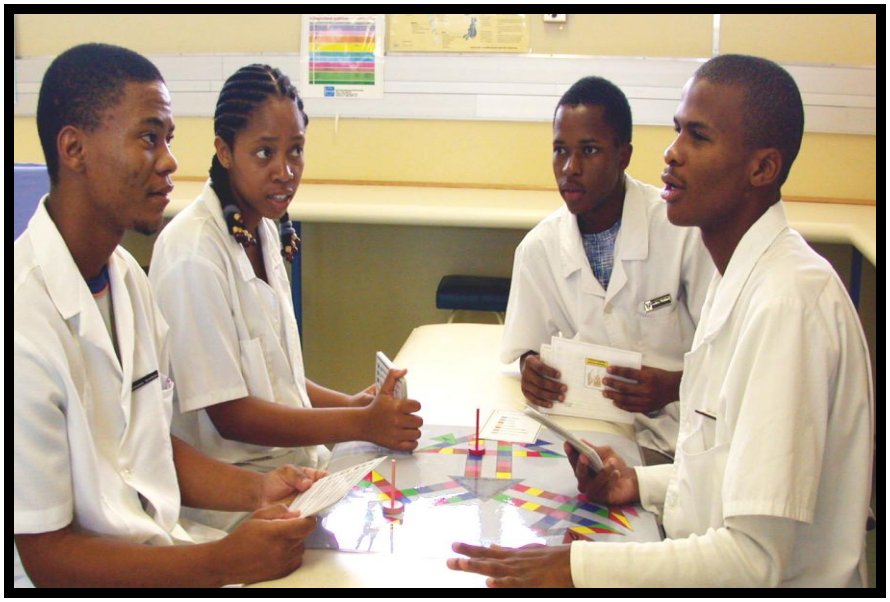


Exhibit 6. Groups of medical students (two students per team) in the process of playing the MMFWF board game in a relaxed, informal, yet healthy competitive atmosphere.

3 CATEGORISATION OF THE MMFWF BOARD GAME

Based on the system used by the German Game Archive (GGA) at the University of Marburg in Germany, Bochennek et al. (2007) proposed a concept to categorise 19 different medical board games. Two main criteria were considered to develop this categorisation concept, namely the mechanism of the game, and the complexity of the underlying concept of learning by experience. Using the game mechanism, medical games were divided into six categories, coded I to VI, irrespective of the specific topics covered by different games (Bochennek et al., 2007).

With regard to the complexity of experiential learning cycles as a categorisation criterion, Bochennek et al. (2007) distinguished between one-, two-, three- and four-stage game models. They used flipping a coin as an example of a single-stage game, with 'experience followed by experience' representing the anticipation of the result of the next throw based on experience alone. In two-stage games, reflection follows experience, where a question has to be answered and the answer needs to be evaluated, followed by the next question. Simple quiz games could be regarded as typical two-stage games. In a three-stage game, experience is followed by reflection, which in turn is followed by a new plan for the next cycle. Quiz games which allow, for example, choosing between different categories from which to be questioned, are examples of three-stage games. Games that include experience, followed by reflection, followed by an abstraction of the issue and then by planning the next step of experience, represent the four-stage model (Bochennek et al., 2007: 942).

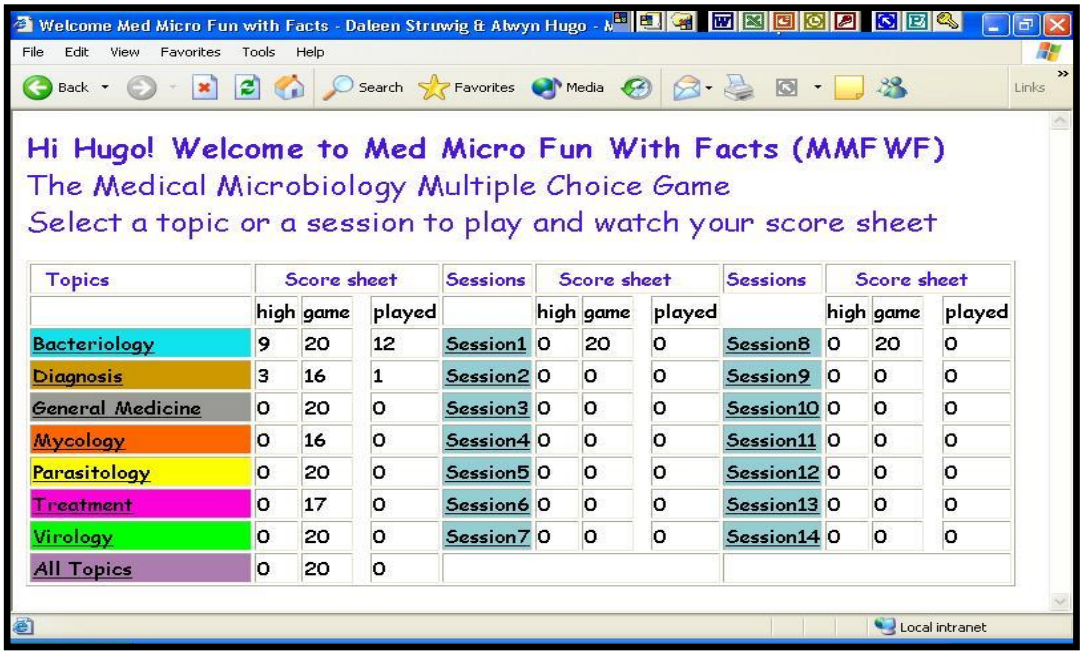
Eleven (57.9%) of the 19 board games evaluated by Bochennek et al. (2007) were classified as category IV games (quiz- and communication-type games). With the proposed categorisation concept as basis, MMFWF can be classified as a category IV, two-stage (IV/2) game, that is, a quiz game using a question-and-answer approach. In a two-stage model, the answer to a question is evaluated as either correct or incorrect and may result in discussion of the answer ('reflection') between players or teams of players before the next question is asked. Two-stage games offer a learning process that emulates a test- or exam-like situation, and many games intended for learning subject content are based on this model (Bochennek et al., 2007).

4 CONVERSION OF THE BOARD GAME TO AN ONLINE APPLICATION (E-MMFWF)

Based on recommendations by staff and students after evaluation of the MMFWF board game, a special programme to run the web-based application was written in PHP and MySQL by a colleague in the Faculty of Health Sciences, UFS. The existing question-and-answer database was expanded and converted into multiple-choice questions. For each question, there was one correct and three incorrect options. However, great care was taken to ensure that the incorrect options were not obvious, and that selection of the correct answer would require either sound knowledge of the topic or good reasoning skills to make the final choice. In addition to presenting the questions in the same colour-coded categories as those of the physical board game, the questions were also indexed according to the individual sessions of the Infections module. Exhibits 7 (a) and (b) show examples of displays (screen shots) from the e-MMFWF web-based application.

The columns under 'Score sheet' in Exhibit 7 (a), titled (i) 'high', (ii) 'game' and (iii) 'played', refer to (i) the logged-in student's personal highest score for that category or session, (ii) the highest score for that category or session obtained by another student, and (iii) the number of times each category or session has been played by the logged-in student. For example, in the category 'Bacteriology', the logged-in student's personal highest score is 9 out of 20, compared to the highest score of 20 obtained by any student, while the logged-in student has already played this specific category a total of 12 times.

Approximately 30% of the questions included in the e-MMFWF version of the game are supplemented with photographs or graphic images. Each image shows the reference from which it was obtained. Sound effects have also been incorporated in the programme. A wrong answer gets one of 20 'bad' sound responses (for example, the sound of crockery breaking), while a correct answer gets one of 20 'good/nice' sound responses (for example, the sound of an excited crowd cheering). The primary purpose of adding the sound effects was to reduce the potentially serious and formal atmosphere that could have been associated with playing an 'academic computer game'. This tactic, however, was entirely based on speculation and personal experience.



Topics	Score sheet			Sessions	Score sheet			Sessions	Score sheet		
	high	game	played		high	game	played		high	game	played
Bacteriology	9	20	12	Session1	0	20	0	Session8	0	20	0
Diagnosis	3	16	1	Session2	0	0	0	Session9	0	0	0
General Medicine	0	20	0	Session3	0	0	0	Session10	0	0	0
Mycology	0	16	0	Session4	0	0	0	Session11	0	0	0
Parasitology	0	20	0	Session5	0	0	0	Session12	0	0	0
Treatment	0	17	0	Session6	0	0	0	Session13	0	0	0
Virology	0	20	0	Session7	0	0	0	Session14	0	0	0
All Topics	0	20	0								

Exhibit 7 (a). The e-MMFWF page displayed after logging in to the game, showing the different options of categories and sessions available to be explored.

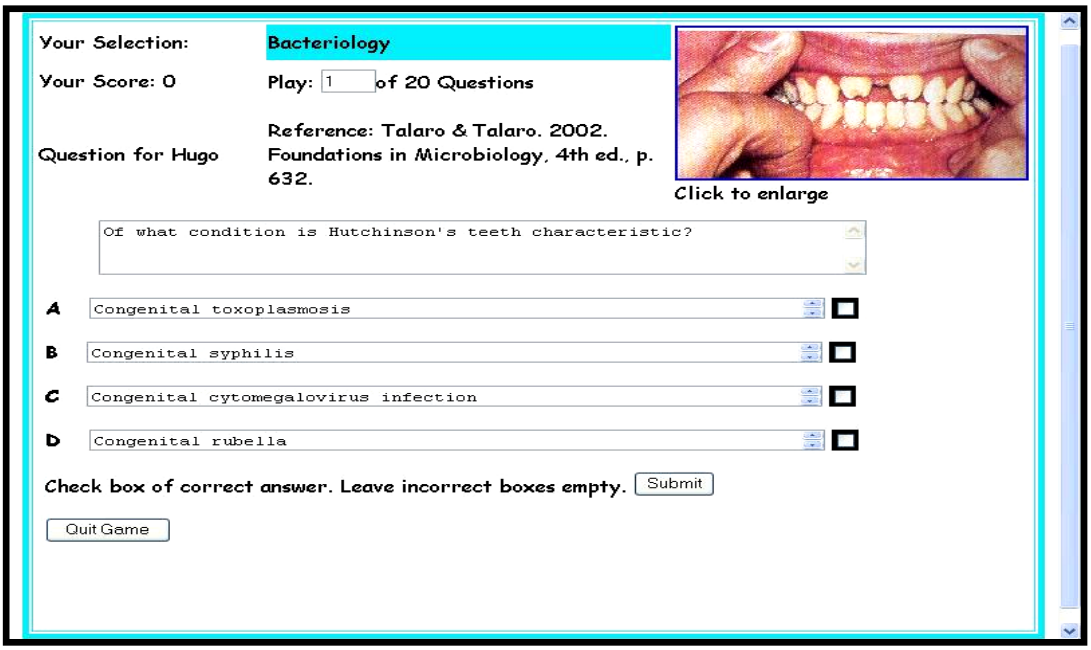


Exhibit 7 (b). Example of a question page with a multiple-choice question presenting four possibilities from which the correct answer has to be selected.

5 CONCLUDING REMARKS

In the case of medical microbiology and infectious diseases, playing a game such as MMFWF may not necessarily prepare the student for an integrated, clinically oriented approach to a patient's health problems and pathology. A comprehensive focus on patient-directed issues – taking a history, doing a physical examination, assessing signs and symptoms, making a diagnosis, and planning the management and treatment of the patient – is to a large extent developed during clinical training in the senior years (4^{th}- and 5^{th}-year) of medical school. Successful integration of knowledge acquired in the pre-clinical years, however, necessitates proper mastery of the subject content of the different basic sciences, of which the Infections module is an integral part. In other words – with regard to infectious diseases – practicing clinical medicine, interpreting the symptomatology of this class of disorders, making a correct diagnosis and planning the patient's therapy, require sound understanding and full ownership of the building blocks of medical microbiology as a basic clinical science.

The importance of establishing a solid foundation in the basic sciences during the pre-clinical years of medical training, has recently been emphasised in the literature (Grande, 2009; Pawlina, 2009). What MMFWF offers, are the elementary building blocks of microbiology as a fundamental discipline in the pre-clinical training of medical students. Only when a student knows the names of microorganisms, which specific diseases they are commonly associated with, how to diagnose infections clinically and by means of laboratory investigations, and which antibiotics can be used successfully in the treatment of infectious diseases, will he/she be able to approach this particular class of medical conditions as an integrated, complex 'structure' consisting of individual, yet interdependent building blocks. From a core knowledge perspective, a student needs to master the basic facts of a discipline before he/she can apply that information in a real and challenging practical situation.

PART III

FIVE ARTICLES

ARTICLE I

An innovative approach to the management of knowledge overload in medical microbiology

ARTICLE II

A gaming approach to learning medical microbiology: students' experience of flow

ARTICLE III

Evaluation of a microbiology and infectious diseases board game by medical teaching staff using direct observation and the nominal group technique (NGT)

ARTICLE IV

The comorbidity of content overload, poor motivation, surface learning, suboptimal retention of knowledge, and a Zeigarnik-like effect in undergraduate medical microbiology: what is the prognosis?

ARTICLE V

A case study on the use of an online multiple-choice game to improve students' academic performance in the Infections module of an undergraduate medical programme

ARTICLE I

AN INNOVATIVE APPROACH TO THE MANAGEMENT OF KNOWLEDGE OVERLOAD IN MEDICAL MICROBIOLOGY

An innovative approach to the management of knowledge overload in medical microbiology

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Abstract

Huge amounts of new information often result in students approaching their studies with the exclusive objective to pass assessments and obtain a qualification. Consequently, the potential enjoyment of the learning process, deeper learning, integration of concepts, and retention of knowledge are lost. Informal/playful learning is usually associated with invigorating emotional awareness, which promotes academic achievement and the development of general/social skills. In order to address students' lackluster perception of medical microbiology in an innovative way, *MedMicroFunWithFacts (MMFWF)* was developed as a quiz-type board game, and evaluated by means of various qualitative methods as a potential learning tool. The original question-and-answer database was then converted into a multiple-choice-question format, web-based application (*e-MMFWF*), as an independent learning and self-assessment instrument in the Infections module of the Free State University undergraduate medical curriculum. This article reports the impact of *MMFWF* on students' perception of microbiology, skills development and academic achievement in the module.

INTRODUCTION

When Albert Einstein said, 'I have no special talents. I am only passionately curious' (Quotations.about.com 2004), he not only made a profoundly humble statement regarding his superior and impressive abilities, but also, perhaps

unwittingly, touched the very heart of the most basic reason for learning. From his statement it could be deduced that curiosity is on of the most vigorous driving forces behind *true* learning, whether it involves the creation of new, or the scrutiny of existing knowledge. Without a deep-seated curiosity, no scholar would ever be able to appreciate the power and luxury of knowing.

Perhaps every academic involved in student training should ask him- or herself: 'What is my students' *true* motivation for learning?' In general, what is really deep-down any student's genuine motivation for learning? The French author and educator, Dorothy de Zouche, once said that if she could not give a student any other reason for learning than passing a test or exam, or the grades on his report card, she might just as well clean up her desk, close her classroom door and go home (Zona-pellucida.com 2002). If a student could really enjoy the learning process, the experience of positive affect or emotional awareness might probably contribute to the development of lifelong learning skills.

Enjoyment is often associated with doing something informal, non-threatening, relaxed – like play. Play has been described very early in Greek and Roman literature as an integral part of personal growth, intellectual and social development, and learning, not only in children, but individuals of all ages. In fact, the root of the words play and learn in the Greek language are very closely related: paideia () refers to learning, while paidia () refers to play (Krentz 1999). There are also numerous reports in the academic and medical education literature that describe the use of a play-approach in the process of learning (Herselman 2000; Howarth-Hockey and Stride 2002; Rieber 1996; Robertson and Tannahill 1986; Schwieger and Hasnip 1986).

IDENTIFYING THE PROBLEM

Microbiology and infectious diseases has a reputation as a subject that it is not particularly enjoyed by most medical students. Several reasons contribute to this experience, such as the massive amount of work, new terminology, complex concepts, and especially all the names of the different types of microorganisms (Beylefeld 1996; Bezuidenhout and Nel 2002; Bezuidenhout and Van der Westhuizen 2003). Add mediocre presentation skills resulting in boring lectures – also a fairly common complaint as reflected by students' evaluation of the module on an annual basis (Bezuidenhout and Nel 2002; Bezuidenhout and Van der Westhuizen 2003) – to this 'mixture', and you have an almost perfect formula to destroy students' potential enjoyment of, and enthusiasm towards the subject. Students who have a negative experience of a subject will most probably have only one goal in mind, and that is to pass this subject or module in order to continue with the next academic year (Struwig 2003). Such an approach and attitude might not be conducive to the cultivation and attainment of lifelong learning skills.

EXPLORING A SOLUTION

When the decision was made that this problem needed attention, it first of all had to be confirmed that many medical students had a negative perception of and attitude towards medical microbiology, which is a compulsory module in the undergraduate Programme for Professional Medicine leading to the acquisition of an MBChB. degree. This was done by means of a questionnaire survey. Supported by the fact that informal learning could be valuable and vigorous (Herselman 2000; Howarth-Hockey and Stride 2002; Krentz 1999; Rieber 1996; Robertson and Tannahill 1986; Schwieger and Hasnip 1986), an almost eighteen-year-old ambition, which involved the development and introduction of the *Med Micro Fun With Facts (MMFWF)* board game, was fulfilled. About six months later, a further development ensued in the form of a web-based application of the board game, which was named *e-MMFWF*.

Before a brief description of *MMFWF* and *e-MMFWF* is given, it should be pointed out that both versions of the game had been evaluated by means of various qualitative research methods. *MMFWF* was evaluated by means of (i) a questionnaire survey administered to the students who participated in the play process, (ii) direct observation of the play process by purposively selected members of faculty, (iii) focus group interviews with stratified randomly selected students representing the participants in the introductory phase of the game, and (iv) the nominal group technique with module leaders and managerial members of faculty involved in the MBChB. curriculum. *e-MMFWF* was evaluated by means of a questionnaire survey administered to (i) subject experts in the field of medical microbiology (i.e. medical scientists, specialist pathologists/consultants, medical technologists, and post-graduate students), (ii) participants in the nominal group technique, from which a strong suggestion to develop the 'computerised version' of the game was generated, and (iii) second-year MBChB. students who played the web-application of the game as part of their compulsory directed learning in the MJR 224 (Infections) module of the curriculum.

A BRIEF DESCRIPTION OF MMFWF AND E-MMFWF

In principle, the *MMFWF* board game is broadly based on the popular general knowledge game Trivial Pursuit, which took the world by storm in the early 1980s. *MMFWF* consists of a playing board, one hundred question-and-answer (Q&A) cards, as well as different-coloured play-('sticks') and reward ('doughnuts') tokens. Each Q&A card contains seven questions with its correct answer, representing the seven colour-coded categories into which the game has been divided, namely six medical microbiology categories (bacteriology, virology, mycology, parasitology, clinical and laboratory diagnosis of infectious diseases, and treatment, management and prevention of infectious diseases) and one general medicine category. The latter category has been added to the game in order to (i)

prevent the potential boredom of dealing with only medical microbiology facts while playing the game, and (ii) to expose the participants to informative and interesting facts of medicine outside the field of medical microbiology.

The complete set thus contains a total of seven hundred questions and answers. Almost 20 per cent of the questions are marked 'VBOC' (view back of card), which indicates that the particular question has been supplemented with a suitable photograph or graphic images to either provide a hint to the answer, or illustrate, for example, the appearance of a particular microorganism, or a specific clinical feature of an infectious disease.

A strong suggestion to convert the board game into a 'computerised version' had been received from the participants in the nominal group technique. Instead of viewing such a development as a potential future product of the study, the challenge was accepted: the programme to run the web-based application was written in PHP and MySQL by one of the authors (A. P. Hugo), and the existing Q&A database was expanded and converted into multiple choice questions. Apart from presenting the Q&A database in the same colour-coded categories as those of the physical board game, all the questions were also indexed according to the individual sessions of the MJR 224 module. We are currently in the process of classifying the questions according to the systems of the human body as well, so that students will have the option to play not only in the original categories or sessions of the module, but also, for example, infections of the respiratory, cardiovascular, central nervous systems.

Approximately 30 per cent of the questions are supplemented with photographs or graphic images. Sound effects have also been incorporated in the programme: a wrong answer gets a 'bad' sound response, while a correct answer gets a 'good/ nice' sound response. The primary purpose of adding the sound effects was to reduce the potentially serious, formal atmosphere most probably associated with playing an 'academic computer game'. This tactic, however, was entirely based on speculation and personal experience.

After a particular category or session has been played (each round of play provides the student with twenty randomly selected questions), the 'score board' contains the highest individual score obtained, the highest over-all score which is shown in order for the student to compare his own performance with that of his peers, and the number of times each category/session has been played by the student.

IMPLEMENTATION OF E-MMFWF AS COMPULSORY DIRECTED LEARNING

Three weeks prior to the first semester test of the MJR 224 module, the students (MBChB. II; n = 146) were informed by means of a personal notification regarding the website where *e-MMFWF* could be accessed. They were encouraged to make use of this application as part of their preparation for the forthcoming test, yet only

3/146 (2 per cent) of the students accessed the website. The test results were quite disturbing and indicative of serious academic jeopardy for an unacceptably large proportion of the class (see Results).

Five weeks prior to the second semester test, the module leader visited the class to (i) discuss the outcomes and potential implications of the first test results, (ii) give the students a motivational talk to boost their confidence in view of their preparation for the next test, (iii) give a practical demonstration of the *e-MMFWF* web-based application; and (iv) inform them that playing Sessions 7–12 (which were covered in the second test) has been launched as compulsory directed learning. Students who had obtained less than 55 per cent for the first test were required to play each session at least three times, while those who obtained a mark of 55 per cent or more, had to play each session at least twice. The implementation of this measure was met with a willingness to co-operate by most students, in particular those who regarded themselves as 'in trouble' after the first test.

RESULTS AND DISCUSSION

The impact of the MMFWF board game

The students who participated in the introduction and evaluation of the *MMFWF* board game (January/February 2003; n = 100) had by then successfully completed the MJR 224 module of the curriculum during the previous academic semester (July – November 2002). The selection of this group of students to participate in the study was based on two primary factors: (i) they would be able to evaluate the *MMFWF* game as a potential learning tool in the MJR 224 module from a retrospective point of view, and (ii) since they had already passed the module, they would most probably not regard the exposure to the game content as a test of their knowledge, and therefore a threatening experience. Before they played the game on three consecutive occasions, they completed a self-administered, 5-point Likert scale questionnaire in order to, inter alia, investigate their experience of, and attitude towards medical microbiology and infectious diseases. In a second questionnaire survey, the impact of the game on their enthusiasm towards the subject was investigated (figure 1).

The first questionnaire survey probed their self-perception with regard to future lifelong learning in medical microbiology by means of statements such as 'I can see myself as an independent lifelong learner in medical microbiology'. It could be hypothesised that a student who does not enjoy a subject and lacks enthusiasm and a positive attitude towards that subject, may most probably be seriously disadvantaged regarding the development of skills required for lifelong learning. From the opposite perspective, it might be argued that a student who does not see himself as a lifelong learner in a particular subject, is in fact reflecting a lack of enjoyment of and enthusiasm towards that subject. The impact of the game on students' self-perception regarding lifelong learning is shown in figure 1.

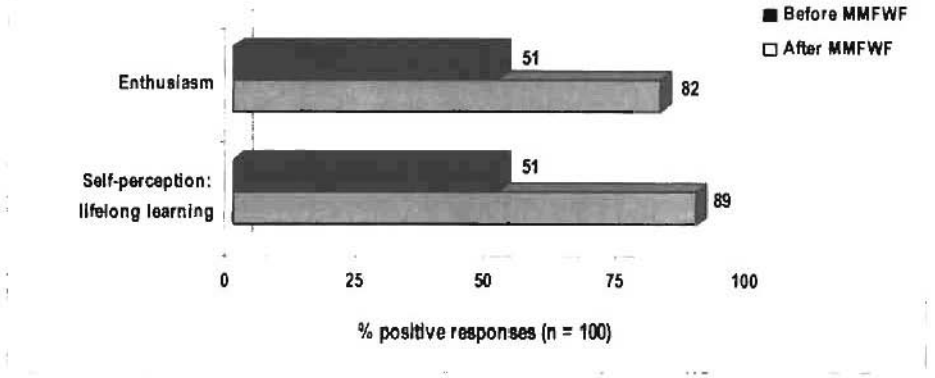

Figure 1: Impact of *MMFWF* on students' perception of and attitude towards medical microbiology (2003) ($p < 0.05$; McNemar's test)

From the feedback reflected in figure 1, it is evident that playing the *MMFWF* board game had a positive impact on students' enthusiasm towards medical microbiology. A statistically significant ($p < 0.05$; McNemar's test) improvement of 31 per cent was observed. A similar trend was observed concerning their self-perception with regard to lifelong learning in the subject, where a statistifcally significant ($p < 0.05$; McNemar's test) improvement of 34% was observed. Even if only these two aspects (i.e. enhanced enthusiasm and the development of lifelong learning skills) had been the primary focus of the game, the findings portrayed in figure 1 would have satisfied the objective of the study, namely the promotion of enjoyment of, and a positive attitude towards medical microbiology and infectious diseases.

Apart from its impact on students' enthusiasm towards medical microbiology and self-perception regarding lifelong learning in the subject, *MMFWF* contributed positively to various other aspects of their perception of the subject and the potential application of the game in the MJR 224 module. Figure 2 shows the results obtained regarding their general perception of the game.

From the feedback portrayed in figure 2 it is clear that the vast majority of students (> 80 per cent of the participants) had a very positive experience of the *MMFWF* board game. Not only did 95 per cent of the participants indicate that they agreed with the statement that play in general could be employed as a meaningful learning opportunity, but 94 per cent of them also gave a positive response to both the questionnaire items 'I think *MMFWF* can be applied in a meaningful way during group work sessions', and '*MMFWF* can be a useful learning instrument for students in medical microbiology'. Ninety-two percent of

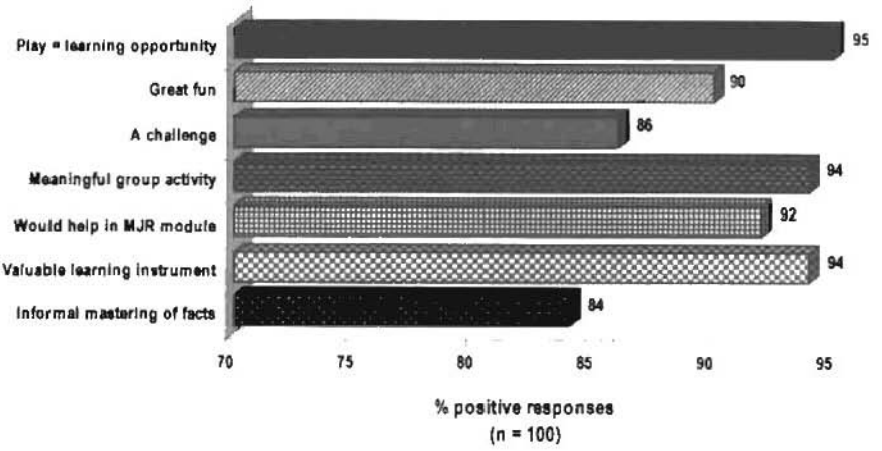

Figure 2: Students' general experience of the *MMFWF* board game as a potential learning instrument in the MJR 224 (Infections) module (2003)

the students agreed that *MMFWF* would have helped them to master the study content of the MJR 224 module. Ninety percent of the participants indicated that playing *MMFWF* was great fun, while 86 per cent experienced it as a challenge.

Basic general skills, such as participation and communication within a smallgroup context, are regarded as critical curriculum outcomes of an undergraduate medical programme, as proposed by the HPCSA (1999). Although group work is strongly recommended, most students did not regard it as a successful component of the module (Bezuidenhout and Van der Westhuizen 2003; Struwig 2003). Consequently, group work has been limited to a level of basically nonexistence in the MJR 224 module. The feedback obtained after *MMFWF* had been introduced to the students, however, emphasised the additional potential of the game to contribute to the development of general skills. Figure 3 demonstrates the participants' positive experience of the game with regard to, inter alia, smallgroup interaction, verbal exchange of knowledge with peers, and spontaneous discussions that developed in response to exciting, interesting and/or challenging questions.

From the results portrayed in figure 3, it is evident that the game has a strong potential to allow the development and practicing of certain critical skills. The students agreed hat playing in teams was better than playing individually (97 per cent). Only 9 per cent of participants indicated that they would have preferred to play on their own. Ninety-nine percent of participants reported active group interaction during the process of play, while 95 per cent and 97 per cent, respectively, viewed the game as an opportunity to exchange knowledge with their peers and to express their knowledge verbally. Eighty-three percent of the students

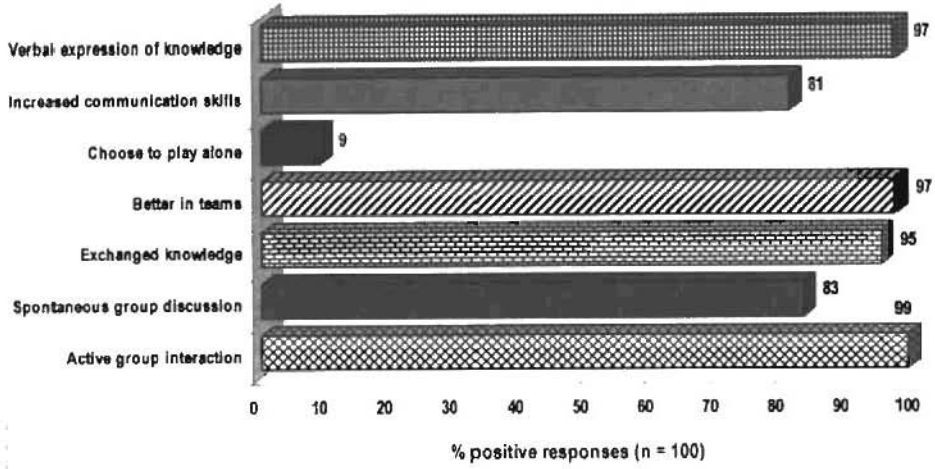

Figure 3: The impact of the *MMFWF* board game on the potential encouragement of critical curriculum outcomes (2003)

reported the occurrence of spontaneous group discussions during play, while 81 per cent felt that playing the game would support the development of communication skills.

The impact of e-MMFWF

As explained in the paragraph entitled 'Implementation of *e-MMFWF* as compulsory directed learning', compelling the students to access the web-based application of the game could in effect be regarded as an 'emergency intervention'. Despite the fact that some of them most probably did not consider themselves as 'in trouble' due to good marks obtained for the first semester test, the evaluation of *e-MMFWF* by means of a questionnaire survey reflected a very positive experience on their part. One hundred and sixteen students from a total population of 146 (79 per cent) completed the questionnaire. Figure 4 presents their general experience of *e-MMFWF*.

From the feedback depicted in figure 4, it is clear that *e-MMFWF* was received with enthusiasm. Ninety-four percent of the respondents indicated that they considered *e-MMFWF* as a useful learning instrument, while 97 per cent believed that it could be applied as a self-assessment tool.

Apart from the positive experience of the *e-MMFWF* application in general, it also had an encouraging influence on students' perception of, and attitude towards medical microbiology, as shown in figure 5.

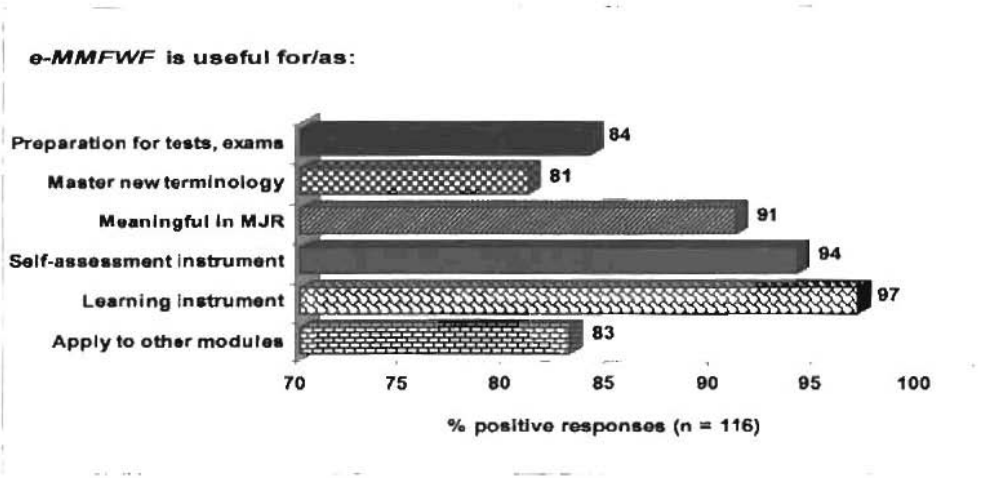

Figure 4: Students' general experience of e-*MMFWF* (2004)

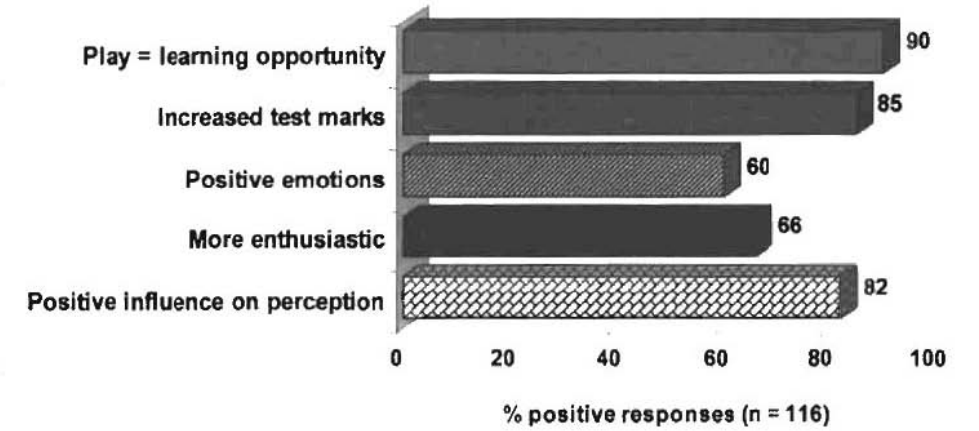

Figure 5: The impact of e-*MMFWF* on students' perception of and attitude towards medical microbiology (2004)

Similar to the feedback received with the evaluation of the *MMFWF* board game, 90 per cent of the respondents indicated that play in general could be employed as a meaningful learning opportunity. Eighty-five percent of the respondents gave a positive response to the questionnaire item 'I would say the exposure to the MMFWF web game (sessions 7–12) contributed positively to the

increase in my marks from Test 1 to Test 2.', while 82 per cent indicated that they had a more positive perception of medical microbiology after playing *e-MMFWF*. The fact that only 60 per cent of students experienced positive affect during the process of playing *e-MMFWF* could most probably be attributed to individual learning styles, a factor that has not been investigated in this study.

Only 66 per cent of students felt more enthusiastic towards medical microbiology after playing *e-MMFWF*, as opposed to 82 per cent who were more enthusiastic after playing the *MMFWF* board game. A possible explanation for this occurrence might be the fact that the board game was played in groups, which in itself was a quite enjoyable experience, as deduced from the amount of boisterous conversation and laughter coming from the participants. *e-MMFWF*, on the other hand, was accessed on an individual basis, most probably as a serious learning activity, since its utilization was primarily intended as a compulsory component of preparation for the impending second semester test.

An encouraging outcome was the observation that 65 per cent of students accessed *e-MMFWF* more than the required number of times, while 28 per cent accessed more sessions than the six (sessions 7–12) that were regarded as compulsory directed learning. Despite the fact that 68 per cent of students indicated that playing *e-MMFWF* on a regular basis would probably facilitate the development of lifelong learning skills in medical microbiology, only 29 per cent of them said they would continue to access the application after they had successfully completed the MJR 224 module.

Another observation justifying reference, is the fact that 51 per cent of the students who accessed the *e-MMFWF* web application, indicated that they were stimulated to do more reading on certain topics, as opposed to only 27 per cent of students who played the board game. This difference may be ascribed to the fact that the group who played the board game had already completed the MJR 224 module, while those who accessed the web application were still busy with the module and probably felt that they needed more information for test and exam purposes. One would expect a greater proportion of medical students to do independent self-study by voluntarily doing additional reading. However, the increase of 24 per cent in participants who reported an eagerness towards additional reading in the group who accessed *e-MMFWF*, supports the proposition that the application should be employed as a supplementary learning aid in the MJR 224 module.

The impact of *e-MMFWF* on the students' academic performance in the MJR 224 module deserves to be emphasised. Figure 6 portrays the improvement in test results from the first to the second semester test. The possibility cannot be denied that multiple factors not investigated in this study, and unrelated to playing *e-MMFWF*, might have contributed to the improvement in test marks. It should be kept in mind, however, that 85 per cent of respondents who participated in the evaluation of *e-MMFWF* by means of a questionnaire survey, indicated that their exposure to the web application played a significant role in their improved test

performance. It could therefore be concluded with a relatively high degree of confidence that the single most compelling factor leading to better marks in the second semester test, was the implementation of *e-MMFWF* as a compulsory learning opportunity.

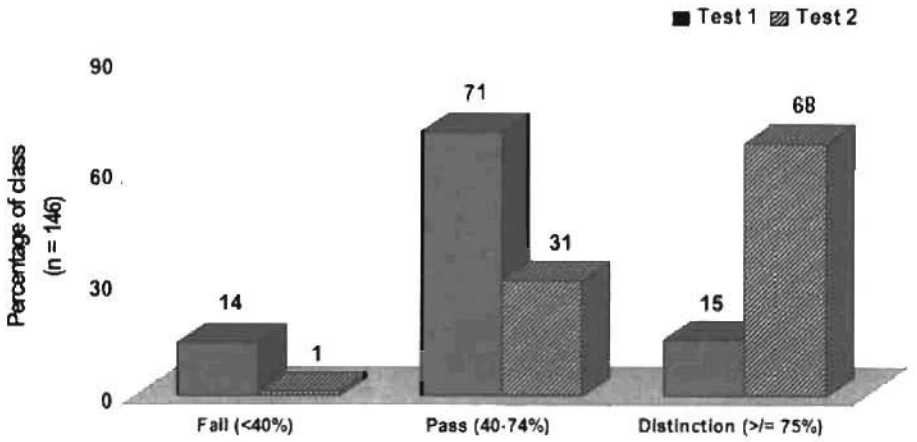

Figure 6: Comparison of Test 1 and Test 2 results in the MJR 224 (Infections) module, July – November 2004

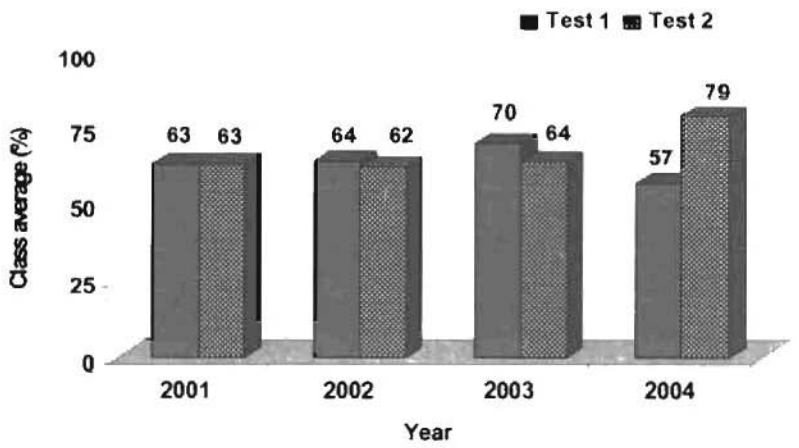

Figure 7: Comparison of class average on smester tests 1 and 2 in the MJR 224 (Infections) module over a four-year period (2001–2004)

Figure 7 shows a comparison of the class average obtained for both semester tests over the period 2001 through 2004. The average was the same for both tests in 2001, but a slight decline was observed from test 1 to test 2 in 2002 and 2003.

Various aspects of the 2004 test results were remarkable: the lowest class average for test 1 over this period, as well as the highest class average for test 2, were obtained in 2004; this was also the only year in which the class average increased (i.e. with 22 per cent) from test 1 to test 2. The only difference between 2004 and the preceding three years was the availability of *e-MMFWF* as a learning instrument and its execution as a compulsory directed learning exercise in this module. It may thus be deduced that *e-MMFWF* could in future play an important role in medical students' mastery of the microbiology and infectious diseases study material.

CONCLUDING REMARKS

From the results presented here, it is clear that students not only enjoyed an informal approach to learning, but they also realised the potential of *e-MMFWF* as (i) an instrument to master subject content, and (ii) a self-assessment tool. Exposure to the study material in this manner also had a positive impact on (i) their perception of and attitude towards the module, (ii) the development of general skills, (iii) academic achievement, and (iv) however difficult to prove at this point in time, a proclivity towards lifelong learning in the subject.

Arland Gilbert once said, 'When we accept tough jobs as a challenge to our ability and wade into them with joy and enthusiasm, miracles can happen' (Quotemountain.com 2004). As educators we not only owe it to our students, but mostly to ourselves, to explore stimulating new possibilities in presenting academic information. As a result, we will enthuse those who are entrusted to us in their preparation for life with a sense of exploration and a desire to know for the sheer power of knowing. Furthermore, in the process of doing 'ordinary things' from a different perspective, we will convert our daily tasks to creative and rewarding challenges, and no longer regard it as 'just something that has to be done'. When teaching has lost the joy of discovery, it is impossible to expect learning to be an exciting journey.

ACKNOWLEDGEMENTS

The medical students (MBChB. III class (2003) and MBChB. II class (2004)), who with good cheer participated in the introduction and evaluation of the *MMFWF* board game and the *e-MMFWF* web-based application, respectively.

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ARTICLE II

A GAMING APPROACH TO LEARNING MEDICAL MICROBIOLOGY: STUDENTS' EXPERIENCE OF FLOW

2007; 29: 933–940 MEDICAL TEACHER

A gaming approach to learning medical microbiology: students' experiences of flow

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Abstract

Background: There is a growing awareness in medical education of general skills[1] required for lifelong learning. Such skills are best achieved when students experience positive affective states while they are learning, as put forth by the Csikszentmihalyian theory of flow. This study describes how a quiz-type board game was used in the School of Medicine of the Faculty of Health Sciences at the University of the Free State to address students' negativity towards medical microbiology.

Methods: The study population consisted of third-year medical students who had recently completed the Infections module of the undergraduate Learning Programme for Professional Medicine.

Results: Data gathered by means of two questionnaire surveys and direct observation showed that the game impacted positively on students' perceptions of and attitudes towards medical microbiology as a subject. A high perceived probability of the game contributing to the acquisition of general skills was recorded, since the experience of positive affect during the process of informal learning went hand-in-hand with heightened team effort and spontaneous communication.

Conclusions: This article may be of value to health educators who wish to supplement formal teaching with informal learning so as to enhance not only the recall of factual knowledge, but also the advancement of general skills.

Introduction

Flow, according to the American psychologist Csikszentmihalyi's (1996) theory of optimal experience, is a psychological state that human beings achieve when enjoyment is stimulated while learning takes place. The flow theory is well recognised as a useful framework for studying play and other leisure activities (Csikszentmihalyi 2002), and numerous investigations have revealed that perceptions of competence are positively related to the experience of flow (Kowal & Fortier 1999; Shernoff et al. 2003).

Currently, the relationship between flow and motivation is highly relevant in higher education environments. Much emphasis is given to students' active engagement in learning (Harding 2000; Illeris 2002) and learning is seen to encompass not only the accumulation or assimilation of content, but also the expansion of learners' emotional and social-societal dimensions (Shepard et al. 1999). When learning on this level fails to occur, there may be a lack of interconnectedness between cognition and emotion, according to Illeris (2002). In some instances, impaired learning may thus be the result of negative emotions, such as resistance or lack of enthusiam to learn or study. A lack of positive affect, in turn, may be traced to the manner and/or form in which the learning content is 'delivered'.

A longstanding concern in the Department of Medical Microbiology in the Faculty of Health Sciences, University of the Free State, was that large volumes of learning material and conventional instructional strategies encourage students to become passive absorbers of facts. In response, one of the authors (MCS) developed a quiz-type board game, entitled 'Med Micro Fun With Facts' (MMFWF). The decision to adopt an informal, play approach to the transmission of learning content is supported by educational research, which suggests that a contextual factor such as instructional format can affect students' engagement in the learning process (cf. Feden 1994; Steinert & Snell 1999; Konradt et al. 2003; Shernoff et al. 2003).

Konradt et al. (2003), for example, assert that group support and cooperation, especially when coupled with unusual learning activities, are associated with positive attitudes. A positive attitude, in turn, influences a learner's ability to process material more deeply. The MMFWF board game was designed to introduce students to learning content in an

Practice points

- Social skills are enhanced when students learn in an informal atmosphere.
- Experiences of positive affect during the process of informal learning lead to increased team effort and spontaneous communication.
- Supplementation of formal lectures with informal learning approaches helps to counter feelings of despair related to assimilating the vast factual content of medical microbiology.

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informal group context, with a view to making both cognitive and affective gains.

This paper focuses on the potential of the MMFWF board game to positively influence students' learning experience of medical microbiology and infectious diseases as a compulsory component of the undergraduate Learning Programme for Professional Medicine leading to an M.B.Ch.B. degree. The aims of the study were first, to determine if playing the MMFWF game influenced students' perceptions of and attitudes towards medical microbiology, and second, to review and categorise students' self-reported experiences of the game situation within the framework of Csikszentmihalyi's (2002) flow theory. The latter aim was pursued to obtain a surer sense that playing the game provides a climate conducive to student engagement and thus to the development of skills associated with flow experiences.

Methods

The setting and the game

In cooperation with other researchers in the Faculty of Health Sciences (Beylefeld 1996; Bezuidenhout & Nel 2002; Bezuidenhout & Van der Westhuizen 2003), the authors recorded negative affective states among third-year medical students concerning the medical microbiology part of their learning programme. Sources of negative affect included a sense of being weighed down by the large volume of study material, disturbances caused by incoherent lectures, feelings of being overwhelmed by difficult concepts and numerous terms used for referring to microorganisms, and fear of failure. Negative feelings, according to Osborne et al. (2003), cause students to revert to accumulating (cramming) information and the lowering of academic aspirations to simply passing tests and examinations. Furthermore, warns Quirk (1994), negative feelings also have the potential to diminish learning, stifle creativity and may result in a long-term negative attitude towards learning.

In response to the perception that students were negatively inclined towards medical microbiology, the idea of introducing them to the learning material in an unusual, game-like manner, was born. The MMFWF game is a quiz-style board game similar to the popular board game, Trivial Pursuit™, which took the world by storm in the early 1980s. Since then, the potential benefit of applying the 'Trivial-Pursuit' concept in health education has been recorded by several researchers (Handfield-Jones et al. 1993). The MMFWF game covers six colour-coded categories of medical microbiology content, namely, bacteriology; virology; mycology; parasitology; the laboratory and clinical diagnosis of infectious diseases; and the treatment, management, and/or prevention of infectious diseases. A seventh category, general medicine, focuses on interesting and informative facts of medicine outside the field of medical microbiology and infections.

The physical components of the game comprise a board, which uses coloured squares and triangles to represent the seven content categories; playing tokens ('sticks') and reward tokens ('doughnuts'); and a hundred question-and-answer cards containing visual material/graphic images on the flip side. The feature mentioned last, referred to as VBOCs ('view back of card'), was added to provide clues to an answer, or to illustrate a concept visually, a similar approach to that followed in an infectious diseases colour atlas. Unlike Trivial Pursuit, where the game has a definite winner, the objective of MMFWF is not winning in the traditional sense of the word, but rather the intrinsic satisfaction derived from gaining knowledge in a playful manner. There were thus certain basic rules, but in essence each playing group could determine 'house rules' and facilitation of the game idiosyncratically.

Implementation of the game and collection of data

In gathering data on students' experience of the board game, an approach that resembles the evaluation research method described by Mouton (2001) was followed. Evaluation research is predominantly qualitative in character. Rather than producing quantifiable results that may be generalised for whole populations, this method describes and evaluates the implementation and performance of intervention programmes in their natural settings.

A combination of methods and techniques, including two questionnaire surveys, a focus group interview, direct observation and the nominal group technique, were used to evaluate the potential of the game in helping to reach both cognitive and affective goals. Only the questionnaire and direct observation data had a bearing on the practising of general skills and were, therefore, singled out for analysis and discussion in this paper.

The first, self-administered questionnaire was implemented among 109 third-year students who had completed the module on infectious diseases in the preceding year (November 2002). Participation was voluntary and anonymous. The survey took place prior to exposing these students to the board game. The primary aim of the survey was first, to determine their attitudes towards medical microbiology as a basic, preclinical biomedical science, and second, to establish the nature of the learning strategies they used to process and master medical microbiology learning content. The questionnaire contained a number of previously validated (Du Toit 1999) scales developed for measuring students' enthusiasm towards a subject and concomitant learning strategies that are characterised by the practising of lifelong learning skills. Such skills included independent reading and the utilisation of peers as sources of learning.

A second questionnaire was completed voluntarily and anonymously by one hundred of the same cohort of students after they had played the game on three consecutive occasions. Participants split into seventeen small groups comprising three pairs each (i.e. six members to each group, except for one group with only two pairs) that were formed voluntarily according to their own preferences. The second survey had a dual purpose, the first of which was to determine whether the game had positively influenced students' perceptions of medical microbiology. In the second instance their perceptions of the game as a learning opportunity, requiring

them to demonstrate competence in certain generic skills, were captured. These skills included communicating with peers, the usage of subject terminology, consulting peers and text books, dictionaries and atlases as sources of information, the handling of conflict, and practising negotiation skills.

In both surveys, responses were captured by means of Likert-type 5-point rating scales. The second questionnaire also made provision for open responses. A basic, descriptive analysis of the structured responses was done by means of the SAS software package. The data obtained from this analysis revealed emotional states such as enthusiasm, interest, enjoyment and self-determination to a degree that suggested the experience of flow.

In addition to comparatively measuring whether playing the MMFWF game had positively influenced aspects of lifelong learning measured in the first survey, the second questionnaire, administered after participants had played the game on three occasions, was designed to elicit students' subjective experiences of flow. The instrument contained, *inter alia*, 24 items corresponding to the following subscales that are commonly used for measuring flow (Kowal & Fortier 1999): (a) transformation of time (e.g. 'I couldn't believe how quickly time passed while we were playing MMFWF'); (b) loss of self-consciousness (e.g. 'It was great fun to play MMFWF'); (c) sense of control (e.g. 'I felt in control while we were playing MMFWF'); and (d) receiving unambiguous feedback (e.g. 'MMFWF made me realise how little I remember of what I have learned in module MJR224 [Infections]').

Student responses to items measuring the incidence of flow were first clustered into two distinctive categories denoting either the presence or absence of flow. The next level of analysis involved the merging of clusters in dichotomous pairs, corresponding to the four mentioned subscales. These results were cast in the form of a dendrogram (see Figure 2) to illuminate patterns in the responses not easily discernable in a frequency distribution.

Free comments captured in the second survey were coded to identify excerpts that could be used to further support the finding that playing the MMFWF game had produced flow experiences.

Finally, in order to corroborate whether students' subjective experiences of the game could be trusted, the play process was informally observed by a group of six staff members involved in the Learning Programme for Professional Medicine. Table 1 presents the criteria and standards according to which players were evaluated. It should be noted that this aspect of the study lacked interpretive rigour in the sense that the observers were not required to compare observational notes. Neither were the findings triangulated with comment from student participants.

Results

Influence of MMFWF on the processing and mastery of medical microbiology learning content

A comparison of responses reflecting students' enthusiasm for studying medical microbiology before and after playing MMFWF is given in Figure 1. The potential influence of the game on the use of active learning strategies to process and master medical microbiology learning content and perspectives on aspects of the game that hold a promise of fostering habits of lifelong learning are portrayed. Pertinent items reflecting students' responses to relevant questionnaire items, before and after play, are given in Table 2.

Observed differences in the enjoyment derived from playing MMFWF

Figure 2 gives the overall result of pairing students' perceived emotional states to succinct dimensions of flow. Four dichotomous pairs of response categories, corresponding to the different flow subscales indicated in brackets, emerged: pleasant preoccupation *versus* boredom (transformation of time), enjoyable stimulation *versus* fear of failure (loss of self-consciousness), focused commitment *versus* a disturbed balance between challenge and skills (sense of control), and self-knowledge *versus* rigid predisposition (receiving unambiguous feedback).

Qualitative evidence of positive affect generated by MMFWF

Table 3 abstracts the most common kinds of open-ended comment captured from the open response category in the second questionnaire. Only two negative comments were received, suggesting, first, that playing the game was a waste of time ('It was not nice to waste my time with knowledge that I do not have and to feel even worse about knowledge

Table 1. Criteria and level of achievement (standards) used for evaluating students' experiences of the MMFWF gaming situation.

	Perceived levels/standards that were achieved		
Criteria	Level 1	Level 2	Level 3
Participation	More than adequate	Adequate	Inadequate
Competition	Healthy	Occasionally out of hand	Totally unhealthy
Conflict	Absent	Within normal limits	Problematic
Small group communication	Spontaneous and appropriate	Spontaneous but inappropriate	Forced and inappropriate
Enjoyment	Highly enjoyable	Moderately enjoyable	Not at all enjoyable
Instructiveness	Highly informative	Moderately informative	Waste of time

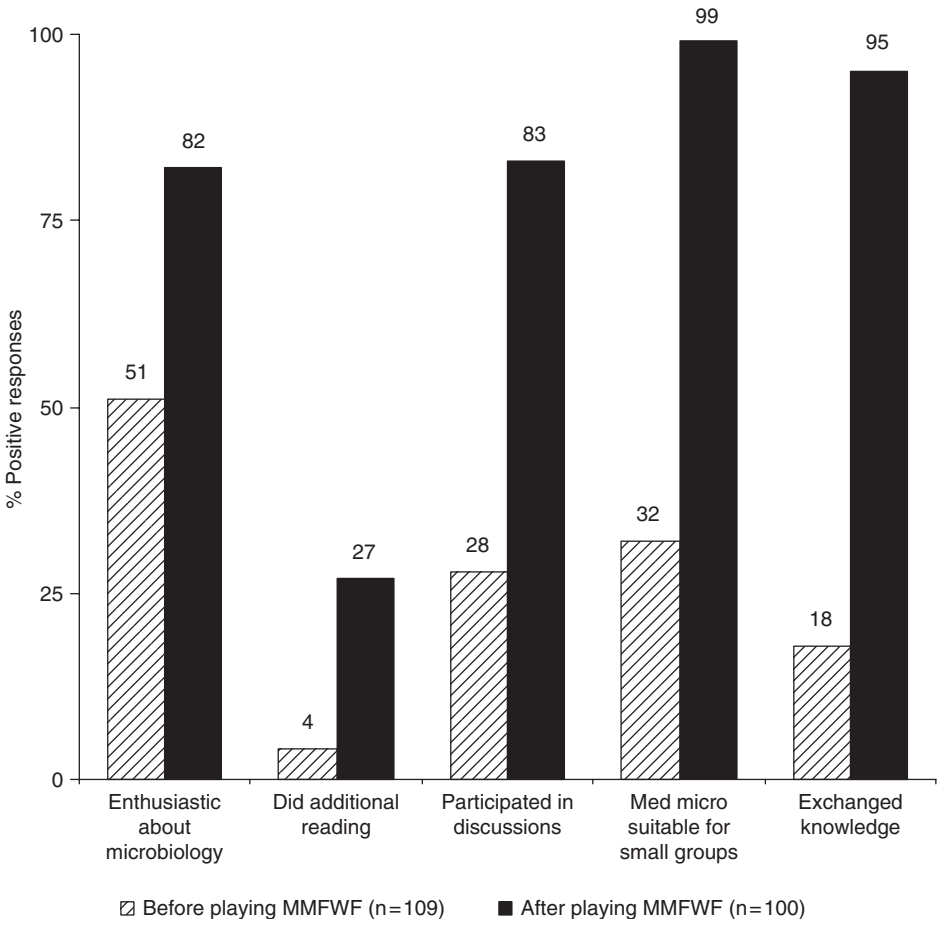

Figure 1. Students' experiences of processing and mastering medical microbiology learning content before and after playing MMFWF.

Table 2. Questionnaire items reflecting the positive influence of MMFWF on students' engagement in active learning.

	Questionnaire 1 (before play)	Questionnaire 2 (after play)
1.	I felt enthusiastic about med micro.	MMFWF had a positive influence on my perceptions of med micro.
2.	I made use of the library and other sources (e.g. the internet) to obtain more knowledge on med micro.	MMFWF stimulated me to do more reading on certain topics.
3.	I participated in discussions in the med micro sessions.	Many of the questions resulted in spontaneous group discussions.
4.	Med micro is suitable to learn in small group context.	There was active group interaction while we were playing MMFWF.
5.	Learning med micro by 'teaching' fellow students in a study group (or an imaginary group) helped me to master the subject content.	MMFWF creates an opportunity to exchange knowledge with fellow students.

that I should have had, but have forgotten already'), and second, that play cannot result in learning ('. . . I believe in a 'no nonsense' approach to learning and living – 'cognosco ergo sum' – I play, therefore I am not'). Conversely, 39 of the open responses revealed positive emotions hinging on feelings of competence, efficacy and autonomy.

Discussion

The results reported here form part of a more comprehensive study, highlighting the need for teachers in medical microbiology to make a conscious effort to convince students of the beauty, fun and excitement involved in the active discovery and construction of knowledge. It was considered crucial to obtain student perceptions of their experience of a gaming approach to the teaching of medical microbiology, because it would reveal mismatches between student perceptions of the intervention and those held by teaching staff (as expressed in nominal groups). It was argued that the extent of positive affect, as perceived by the students themselves, would enable the developer of the game to reflect on possible applied uses of the game; it would convey important information to programme administrators responsible for creating an academic environment conducive to the development of general

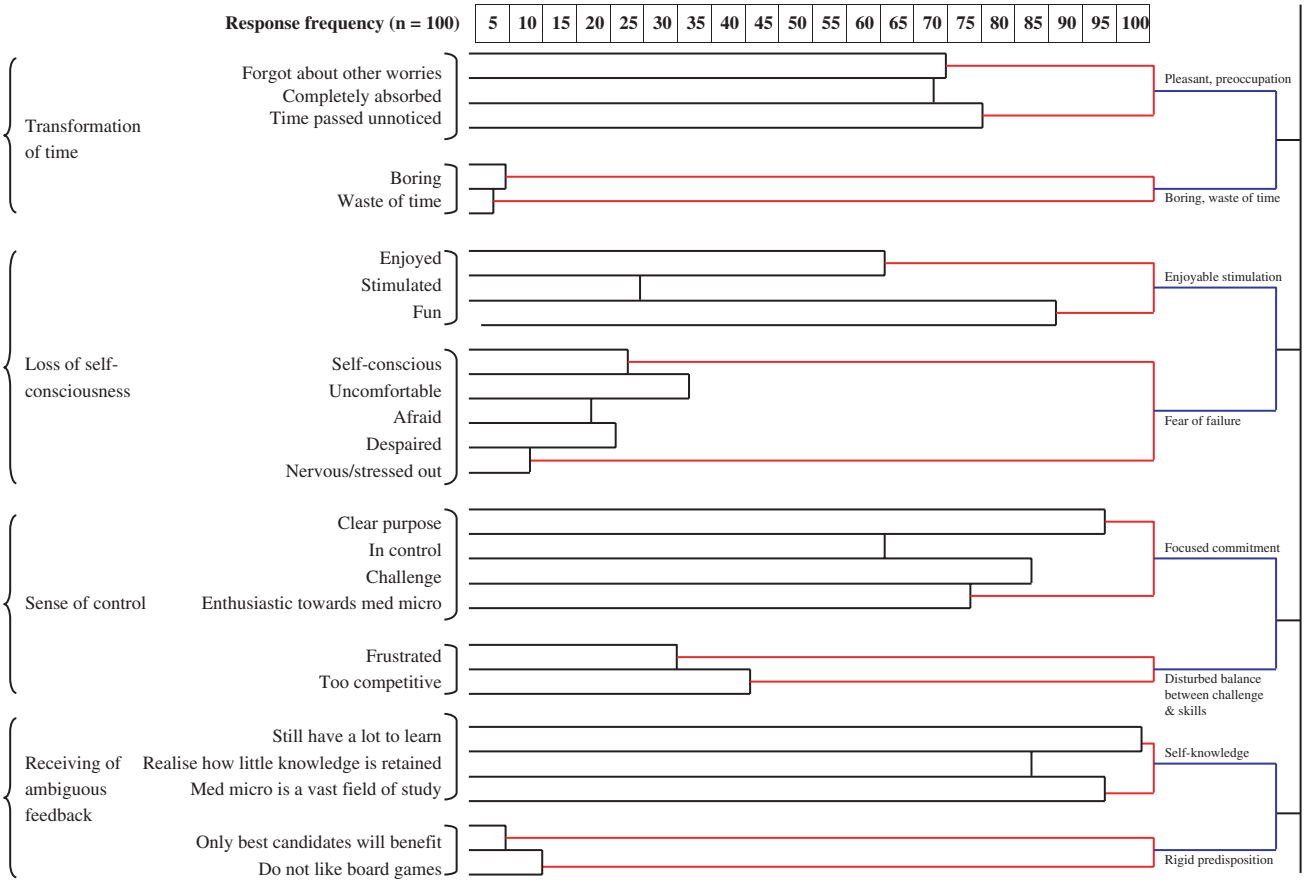

Figure 2. Dendrogram resulting from clustering questionnaire items and corresponding responses reflecting the presence or absence of flow.

Table 3. Positive student responses to a questionnaire item inviting remarks, suggestions and criticism ($n = 39$).

Nature of positive affect associated with the response	Frequency	Illustrative excerpts
Enjoyable	21	'It was very enjoyable and a good way of revising what we have learnt!!' 'I really enjoyed playing the game and would really like to own a copy to enhance and refresh my knowledge in microbiology.'
Fun	7	'. . . overall, the game is beautiful and fun to play.' 'It was great fun to play the game.'
Interesting	5	'Game is very-very interesting and aiding students to comprehend some of aspects on microbiology.' 'It is an excellent way of learning and in an environment of ''games'' it was easier to concentrate and learn.'
Beneficial	1	'MMFWF has been more beneficial to most of us, also improved our knowledge of the area of microbiology that we never had time to go through.'
Encouraging	1	'Very encouraging to learn microbiology. Makes microbiology easier than with notes.'
Enthusing	1	'This could have given us more enthusiasm if we'd played the game that way whilst we were busy with the MJR224 module.'
Exciting	1	'An exciting and fun way of learning overall.'
Meaningful	1	'I think 'Mike'* is for sure meaningful.'
Stimulating	1	'In that way I believe the game would have had a positive influence on our study methods and also stimulated us to want to know more.'

*'Mike' is the colloquial term used by the respondent to refer to MMFWF.

skills; it would alert teachers of medical microbiology who are responsible for fostering greater enthusiasm for the subject to the potential value of MMFWF as a tool for enhancing lifelong learning habits in students.

The most important and consistent finding of this study was that students welcomed the MMFWF game as an invigorating teaching device (see Figure 1). In a subject such as medical microbiology, notorious for the large volume of learning content, a finding such as this offers a possible strategy to counter boredom and enhance retention of knowledge. As such, the concept may be incorporated as a useful adjunct to lectures in other disciplines of medical training as well.

From students' subjective judgment of how the game influenced the manner in which they constructed meaning, it was evident that playing MMFWF was not merely an entertaining experience that produced no learning. As Figure 1 shows, the exercise produced cross-curricular outcomes that went beyond increased factual knowledge. Twenty-seven percent of respondents indicated that the gaming situation encouraged them to use textbooks, dictionaries and other references as sources of learning. Whereas only 18 percent (20/109) of respondents had consulted peers previously, 95 percent reported having exchanged factual knowledge with fellow-students during play ($P < 0.0001$; McNemar's test). Eighty-three percent of respondents actively participated in small group discussions during the game. The profound change in perspectives on the suitability of medical microbiology as a topic for small group discussions (before the game 32 percent [35/109] agreed, while 99 percent [99/100] responded positively afterwards [$P < 0.0001$; McNemar's test]) may similarly be directly related to the pleasant interaction brought about by the game.

In furtherance of the idea that social skills are enhanced when students learn in a relaxed atmosphere, the game will thus be promoted as a means of giving effect to the now popular demand that higher learning should no longer focus on students' cognitive development only, but also on the development of lifelong learning skills and job-related qualities such as participation, communication and collaboration in groups (RSA DoE 1997; Bennett et al. 2000; Fallows & Steven 2000; Ten Cate & De Haes 2000).

The findings depicted in Figure 2 support the researchers' thesis that students would experience flow while playing the game and validate the frequency distribution of positive responses in Figure 1. The boundaries between the dichotomous clusters show that flow was overwhelmingly present in the majority of respondents. On average, 75 percent of respondents indicated that they were pleasantly preoccupied, while a mere 5 percent reported boredom. Concern about failure, a very common, but also an extremely crippling emotion, was experienced by less than a third of the participants. An average of 93 percent of the respondents indicated that the game had made them aware of the fleeting nature of factual retention. In a curriculum that aims to de-emphasise the dominance of rote learning, such an insight is of great value.

The cluster indicating that an average of 82 percent of participants experienced a sense of control, led to the conclusion that the game was perceived as a positive external challenge. The challenge, in this case, came in the form of 'friendly' competition, which required students to use their negotiation skills. Negotiation, in turn, presupposes the application of general skills such as conversing with group members, showing interest in what others have to say, giving and receiving constructive and negative feedback, asking and giving assistance, handling criticism, resolving interpersonal conflict and reaching consensus. Shernoff et al. (2003) refer to the symbiotic relationship between challenges and the skills needed to meet those challenges, by saying that a disturbance in this delicate balance may easily lead to anxiety or apathy. Considering that less than one-third (31%) of the group experienced frustration and 40 percent felt threatened by the competitive atmosphere, as opposed to the 90 percent of participants who indicated that playing MMFWF was great fun, it may be concluded that the MMFWF game provided an appropriate challenge for the majority, accompanied by opportunities to apply coping skills.

Corroboration of students' self-reported positive emotional states was gained by analysing the feedback of academic staff members who observed students' behaviour during play. Figure 3 provides a graphic summary of the evaluation results. Once again, the results were prominently positive. Participation was perceived to be adequate during all stages of play and in nine out of ten possible observational sessions, spontaneous and appropriate small group discussions were reported. In a curriculum that has small group work as one of its tenets, these findings are promising. As noted by Shernoff et al. (2003), it serves as a bridge to more complex tasks when individuals seize opportunities to learn, read, work with others, and gain feedback in a manner that supports their curiosity.

It would be overstating the findings of this study to claim that students also gained cognitively as a result of playing the game, since cognitive outcomes have not been assessed objectively. Congruently, academic staff members who formed the panel of observers, did not perceive the game to be instructive to a notably high degree (six sessions were described as informative, but four out of a possible ten sessions received a mediocre rating of 'fairly informative'). However, it is clear that the exercise favourably influenced students' perceptions of medical microbiology. As depicted in Figure 1, the majority of respondents (82%) reported invigorated levels of enthusiasm after having played the game. For teachers concerned about students' study skills, this is a pleasing outcome. Such a finding builds on Goleman's (1995) claim that people with a positive attitude and feelings of optimism and enthusiasm are capable of motivating themselves, experiencing resourcefulness to the point of accomplishing their goals, reassuring themselves when faced with a difficult situation, and of breaking down a formidable challenge into smaller, more manageable units. Drawing on this theory, the researchers confidently concluded that the MMFWF game might be used to counter feelings of despair related to becoming familiar with the vast number of new facts and terminology in the field of medical microbiology.

Feedback of this kind on the quality of a learning experience is scarce, because, as noted by De la Harpe and Radloff (2000), students are rarely asked to give feedback on

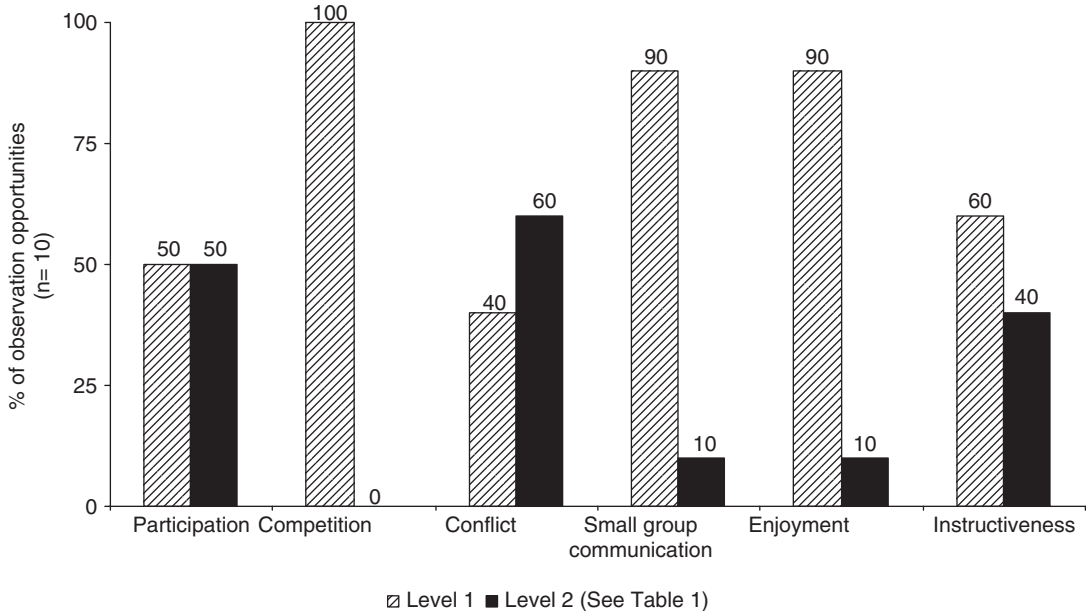

Figure 3. Feedback from the panel of academic staff members on students' behaviour while playing the MMFWF game.

whether and how they make progress in acquiring the skills associated with lifelong learning habits. Without gaining further information on the learning behaviour of students who regularly play the game, the impact of the MMFWF game on their development as lifelong learners in terms of motivation and affect will, of course, be lost. However, the findings of this small-scale study demonstrate that a gaming approach has the potential to positively impact on students' development as lifelong learners.

Conclusion

When students experience a lack of enthusiasm towards a subject and feel demotivated to the extent that their development into lifelong learners in that particular field of study is compromised, the problem needs to be addressed aggressively.

In this study it was posited that the competitive element and anticipated high level of student engagement engendered by a gaming approach to learning medical microbiology, would elicit signals of positive affect. Transferred to other contexts, interpretation of the outcome of the study should take the small sample size and the investigation of only a few, purposefully selected conditions of flow into account. Within the restricted context of the undergraduate Learning Programme for Professional Medicine followed by the School of Medicine at the University of the Free Sate, however, the MMFWF game may rightfully be regarded as a flow-inducing experience providing a variety of opportunities for practising and enhancing lifelong learning habits and skills.

Conflict of interest

Both the authors were involved in the planning, implementation, analysis and writing of this paper. Beyond the different nature of their fields of expertise, they have no conflicts of interest to declare.

Note

1. *General skills* embrace abilities that are essential for academic and work-related success, such as competence in communication, team work, negotiation and problem solving.

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ARTICLE III

EVALUATION OF A MICROBIOLOGY AND INFECTIOUS DISEASES BOARD GAME BY MEDICAL TEACHING STAFF USING DIRECT OBSERVATION AND THE NOMINAL GROUP TECHNIQUE (NGT)

EVALUATION OF A MICROBIOLOGY AND INFECTIOUS DISEASES BOARD GAME BY MEDICAL TEACHING STAFF USING DIRECT OBSERVATION AND THE NOMINAL GROUP TECHNIQUE (NGT)

ABSTRACT

Innovative approaches to teaching and learning are part of the medical education milieu. This paper reports the evaluation of a medical microbiology board game, Med Micro Fun With Facts (MMFWF) by means of direct observation of students involved in the play process, and the nominal group technique (NGT). The game was developed to stimulate medical students' interest in the Infections module of their undergraduate training programme, by exposing them to the subject content in an informal and relaxed way involving healthy competition and active group dynamics. Academic and managerial members of staff involved in the medical curriculum participated in the observation of play and the nominal group interviews. Despite strong criticism from a number of participants with regard to the level of difficulty of the game and the clinical relevance of some of the questions and answers, the game itself, as well as the process of play as demonstrated by the students, received positive feedback overall. Direct observation and the NGT were employed in the qualitative evaluation of the board game as an educational innovation, and several practical suggestions are made that should be taken into account when an improved and updated version of MMFWF is considered.

INTRODUCTION

The word *innovate* had its origin in the mid-16th century and was derived from the Latin *innovare,* meaning 'to renew' (Encarta, 1999:968). In the 1590s, an innovator was also referred to as a revolutionary (Little, Fowler & Coulson, 1944:1010). According to McCoubrie (2007:51), *innovation is the process of introducing improvements developed through study and experimentation,* while Robinson (2009:s.p.) describes an innovation as *an idea, behaviour, or object that is perceived as new by its audience*. The desired outcome is that the innovation originating from creative ideas should eventually be implemented successfully. Implementing and sustaining an innovation in an educational setting, however, is usually a gruelling challenge. Educational innovation has been portrayed as an intricate and multifaceted phenomenon that requires critical examination, especially when the desired outcome is to put the new method or product to effective use (McCoubrie, 2007).

Scott, Plotnikoff, Karunamuni, Bize and Rodgers (2008:42) refer to the *diffusion of innovation theory* proposed by Everett Rogers in the mid-1990s. According to this theory, an innovation must meet specific criteria that will contribute to its acceptance. The attributes required for an innovation to be recognised, include (i) relative advantage; (ii) compatibility; (iii) complexity; (iv) trialability; and (v) observability, which can be explained as follows (Greenhalgh, Robert, Macfarlane, Bate & Kyriakidou, 2004; Robinson, 2009; Scott et al., 2008:42):

- *relative advantage* is the degree to which an innovation is perceived as being an improvement on the product, method or approach it will replace;
- *compatibility* refers to the degree to which the innovation will blend in with its potential users' existing values, past experiences, requirements and needs;
- *complexity* is the degree to which an innovation is perceived as difficult to understand and use; the more simplistic an innovation, the better its chances for being accepted and implemented;
- *trialability* is the degree to which an innovation's usefulness can be evaluated on an experimental basis; new innovations require investment in terms of time, energy and

resources, and therefore innovations that can be tried and evaluated to a limited extent prior to implementation, are usually more readily adopted; and

- *observability* refers to the degree to which the results of an innovation are visible to its users; clearly discernible positive outcomes directly linked to its implementation will promote approval and acceptance of an innovation.

When a novel approach to teaching and learning in medical education is considered, evaluation of the newly designed tool, instrument, process or procedure should not be limited to the specific group of students for whom it is intended. It is important to also involve members of the academic staff from different disciplines in the evaluation of the new product, especially when such an innovation has been designed, developed and introduced to students by a single individual and not a team of collaborating educators. Students and academic staff should be given an equal opportunity to investigate and test the innovation. The critique, comments and recommendations obtained from the two groups of evaluators – that is, students and staff – will represent points of view raised from different levels of academic, clinical and professional development.

Various methods to evaluate change and innovation in medical education are available and have been used successfully in this dynamic field of research. In addition to questionnaire surveys, semi-structured focus group interviews, in-depth interviews and the Delphi technique, other methods that can be used for evaluation of products or programmes, include non-participant direct observation (Cohen, Manion & Morrison, 2000; Flick, 2006; Henning, 2004), and nominal group interviews (Delbecq & Van de Ven, 1971; Cohen et al., 2000).

Observation, as approached from different angles depending on the research issue in question, aims to shed light on the practices, interactions and events which occur in a specific context, and can be conducted from the inside as a participant, or from the outside as a complete observer (Flick, 2006). Henning (2004:81) describes observation slightly differently and explains that it can be applied in qualitative research from two distinct perspectives; (i) where the researcher takes on the role of *the instrument of observation and sees for herself firsthand*

how people act in a specific setting and what that setting comprises, thus observing as a participant; and (ii) where observation is used as an independent tool, and not necessarily as part of fieldwork in which on-site participation takes place, but as part of different research designs. Flick (2006) contends that by using observational methods, the researcher is allowed the opportunity to perceive the various aspects of social construction as they occur in the process of interaction between individuals. Eventually, observational methods result in the production of text as empirical information, of which a verbal description of the event is one example. Observation contributes to research in the sense that *triangulation of observations with other sources of data and the employment of different observers increase the expressiveness of the data gathered* (Flick, 2006:218). In non-participant observation, the theoretical background underpinning the process is that social reality can be analysed from an external perspective (Flick, 2006).

Henning (2004:81) further argues that participatory and generic observation may be classified as non-standardised tools, while *structured observation as a stand-alone tool may be more standardised*. Observation methods are powerful instruments that can be used when obtaining insight into situations is required (Cohen et al., 2000). In general, observation entails visual surveillance and inspection of an environment, circumstances, product, process or incident, and also involves the other senses in addition to seeing or looking. Depending on the research question, and especially from the viewpoint of using it as a research tool or method, observation may be of limited duration and used exclusively as a distinct process to gather information as part of a non-ethnographic study (Henning, 2004). A limitation of non-participant observation is the question of how far the attempt to observe events as they naturally occur, can actually be achieved, as it is known that the act of overt observation in particular, to some extent influences the actions and behaviour of the observed (Flick, 2006). In the research reported here, observation has been employed as an instrument to describe a specific, unique process, namely medical students playing an educational game designed to be used as a supplementary learning tool in medical microbiology and infectious diseases.

With regard to medical education, direct observation is most commonly described as an assessment tool used in the context of clinical training and assessment. Kogan, Holmboe and

Hauer (2009) published a systematic review of the literature on methods and instruments used for direct observation and assessment of medical students' clinical skills with actual patients. Eighty-five articles describing a total of 55 direct observation tools qualified for inclusion in their report. Despite direct observation being regarded as an inherent component of medical education as staff and students work closely together in clinical settings, it has mostly been applied as an informal and infrequently used assessment method across all disciplines (Fromme, Karani & Downing, 2009; Hamdy, Prasad, Williams & Salih, 2003).

In non-clinical educational settings, observation methods can be used to evaluate, for example, (i) students' interaction with each other when participating in a group activity; (ii) students' individual approach to a task, experiment or assignment; (iii) students' response, either individually or in group context, to existing approaches to teaching and learning; and (iv) students' response to and interaction with a newly introduced innovative approach to teaching and learning (Angrosino & Mays de Pérez, 2000; Beylefeld & Struwig, 2007; Gunn, 1999).

Expert opinion is often sought in the development of educational policy and practice. Regardless of the nature of the task, complex decision-making is rarely the responsibility of one person (Clayton, 1997). With the introduction of the Delphi technique (Clayton, 1997; Gordon, 1992; Stahl & Stahl, 1991; Stewart, O'Halloran, Harrigan, Spencer, Barton & Singleton, 1999), it was stated that experts, particularly when they agree, are more likely than non-experts to be correct about future developments in their field (Gordon, 1992). In addition to the Delphi technique, the NGT (Delbecq & Van de Ven, 1971) is one of the formal consensus methods used in qualitative research (Chapple & Murphy, 1996; Cohen et al., 2000; Lloyd-Jones, Fowell & Bligh, 1999; MacPhail, 2001; Murphy, Black, Lamping, McKee, Sanderson, Askham & Marteau, 1998). The NGT not only investigates the level of agreement between participants with regard to group decision making; it also allows for idea generation and ranking of ideas as part of the group process (Chapple & Murphy, 1996; Lloyd-Jones et al., 1999; Murphy et al., 1998). Both the Delphi and nominal group techniques predominantly involve the production of quantitative estimates derived from qualitative approaches (Ruperto, Meiorin, Iusan, Ravelli, Pistorio & Martini, 2008).

One of the advantages of the NGT as opposed to, for example, informal meetings and brainstorming, is that the process of decision making is not dominated by the individual opinions of authoritarian or influential participants (Ruperto et al., 2008). Furthermore, partnerships or alliances representing a strong personal concern in specific affairs, as often encountered in open committee meetings, are avoided (Jones & Hunter, 1995). All participants enjoy equal status and are allowed to make a contribution to the group's delineation of important issues (Cohen et al., 2000).

In the study described in this paper, academic staff members participated in direct observation and nominal group interviews in the evaluation of an innovative approach to exposing students to the subject content of medical microbiology and infectious diseases.

BACKGROUND

At the time of the research, the Infections module was presented in the second academic year in the undergraduate medical (MBChB) curriculum in the School of Medicine, Faculty of Health Sciences, at the University of the Free State.

In a questionnaire-based module evaluation performed by the Division of Health Sciences Education as part of curricular quality assurance [Bezuidenhout & Van der Westhuizen, 2003 (unpublished data)], only 38% of students (n=98) who evaluated the Infections module felt that the time available was sufficient to master the content of the module. In the other eight second-year modules evaluated (mean n=106; range 95–118), a mean of 76% of students (range 56% to 93%) were of the opinion that they had adequate time to master each of these modules' content. The Infections module received the lowest score of all the second-year modules with regard to the balance between time and content volume. Pertaining to students' finding the module interesting, the difference was not as considerable, with 74% of students evaluating the Infections module as very interesting, as opposed to a mean of 88% (range 74% to 95%) in the other modules. One other module received the same rating as the Infections module. The second lowest score with regard to finding the module interesting, was 86%.

In an attempt to address students' grievances regarding the Infections module, the researcher (module leader at the time) developed a quiz-type board game, called Med Micro Fun With Facts (MMFWF), based on the principles of Trivial Pursuit™ (Beylefeld & Struwig, 2007; Struwig, Beylefeld & Hugo, 2005). One hundred third-year medical students who had completed the Infections module the previous semester at the end of their second academic year, participated in the introduction of the game. They rated it by means of a questionnaire survey as great fun (90%); a potentially useful learning instrument for the Infections module (94%); an opportunity to exchange knowledge with fellow students (95%); promoting active group interaction (99%); and leading to spontaneous group discussions (83%). MMFWF was considered to be boring and a waste of time by only 5% and 4% of students, respectively. Most of them (95%) agreed with the statement that play in general can be applied as a meaningful learning opportunity. The majority of students (84%) reported that they acquired new knowledge while playing MMFWF (Struwig et al., 2005).

In addition to these perceived advantages of MMFWF, most students experienced flow as described by Csikszentmihalyi in his flow theory of optimal experience (1996, 2002), while playing MMFWF (Beylefeld & Struwig, 2007). Flow is strongly related to motivation and positive affect, which in turn promotes a satisfying and meaningful learning experience (Ainley, 2006; Dweck & Leggett, 1988; Linnenbrink, Ryan & Pintrich, 1999; Meyer & Turner, 2006; Seifert, 2004).

AIM OF THE STUDY

The aim of the study was to obtain academic staff members' opinion on (i) the students' behaviour and group activities in the process of playing MMFWF; and (ii) the board game as a potential learning tool in the Infections module. The results obtained by means of these two methods could be compared to students' evaluation of the game captured by means of a questionnaire survey and semi-structured focus group interviews. Triangulation of data sources is ensured by making use of different evaluation techniques, which contributes to the validity of the evaluation process (Cohen et al., 2000; Denscombe, 2003; Henning, 2004; Stake, 2000).

METHODS

A descriptive study design was used. Data were generated by means of structured, direct observation (Cohen et al., 2000) of the play process and the NGT (Chapple & Murphy, 1996; Lloyd-Jones et al., 1999).

The direct observation of the play process and the NGT formed part of a larger research project for which ethical approval was granted by the Ethics Committee of the Faculty of Health Sciences, University of the Free State.

Direct observation of the play process

Ten out of 16 academic and managerial members of staff involved in the second year of the undergraduate medical (MBChB) curriculum in the School of Medicine, were invited to observe students' activities and group dynamics while participating in the MMFWF board game. Volunteer convenience sampling was used in the selection of the observers, since they were both easily accessible and presupposedly willing to participate in the study (Teddlie & Tashakkori, 2009), and were considered by the researcher to be representative of the academic staff involved in year two of the medical training programme. Six staff members, of whom five were involved in teaching and one was the programme director of the undergraduate medical curriculum, accepted the invitation. Four of them observed the play process on two separate occasions, and two observed on one occasion each, giving a total of ten sessions of observation.

The observations were scheduled for five sessions of play of one hour each, with two observers involved simultaneously, yet independently. The observers were requested beforehand to move around among the students (approximately 22–25 per session), who played the game in small groups of four to six students, comprising two or three teams of two students each. The students were seated around desks and laboratory-type benches arranged at different points in the Clinical Skills Unit where play took place. A specially designed instrument was used to assess certain aspects of the game as well as the play process, as shown

in the matrix in Exhibit 1 below. Space was provided for open comments and recommendations. The evaluation instruments were collected directly after each session of observation and results were calculated for each of the criteria observed. Analysis of the data was based on counting the occurrence of specific activities by using procedures of categorising (Flick, 2006).

You are kindly requested to indicate by means of a cross (X) the level/standard of achievement that most accurately represents your observation of each of the following criteria with regard to the process of students playing the MMFWF board game. Please write down any comments and recommendations in the space provided.

CRITERIA	***LEVEL/STANDARD ACHIEVED***		
	PERCEIVED AS:		
Participation	More than adequate	Adequate	Inadequate
Competition	Healthy	Occasionally out of hand	Totally unhealthy
Conflict	Absent	Within normal limits	Problematic
Small group communication	Spontaneous and appropriate	Spontaneous but inappropriate	Forced and inappropriate
Enjoyment	Highly enjoyable	Moderately enjoyable	Not at all enjoyable
Instructiveness	Highly informative	Moderately informative	Waste of time

Exhibit 1. Evaluation instrument designed to be completed by observers during direct observation of medical students playing the MMFWF board game.

Nominal group technique (NGT)

For the nominal group interviews, a total of 50 written invitations were sent out to module leaders involved in Phases II and III in the MBChB curriculum, as well as managerial members of staff. Phases II and III represented academic years two and three (pre-clinical

training) and academic years four and five (clinical training), respectively. Nineteen members of staff accepted the invitation, of whom three were in managerial positions (Head of the School of Medicine, undergraduate programme director, and programme organiser), three were involved in Phase III of the curriculum and 13 in Phase II. Based on their availability on three separate predetermined dates, the participants were divided into three groups, of which two groups consisted of six members each and one group of seven members. An independent member of staff, affiliated with the Division of Health Sciences Education, was requested to facilitate the interviews. She was provided with appropriate literature on the technique, as she was not acquainted with the NGT.

In order to provide participants with background information regarding students' experience of the Infections module and the development and purpose of the MMFWF board game, each interview started with an introductory presentation by the researcher. Thereafter participants were given an opportunity to gain practical insight into the game by briefly playing the game themselves. The researcher left the venue before the interviews started.

The facilitator thoroughly instructed the participants on the practical aspects of the procedure, according to the description of the technique by Chapple and Murphy (1996), and Lloyd-Jones et al. (1999). The interviews were constructed as follows:

- Step 1 (20 minutes): introduction and background; explanation of the NGT procedure; presentation of the issues under investigation; these two issues were:
    (1) What are the strengths of such a play approach in the development and promotion of subject-specific factual knowledge and general skills[1]?
    (2) What suggestions can you make towards the improvement of the MMFWF game to be used as a potential group activity in the Infections module?
- Step 2 (15 minutes): writing down of personal responses to these issues in silence;

[1] General skills include abilities that are essential for academic and work-related success, such as competence in communication, team work, negotiation and problem solving (Beylefeld & Struwig, 2007).

- Step 3 (30 minutes): item generation; round robin presentation of listed responses; this step was repeated until the participants did not have any new items to add to the cumulative list;
- Step 4 (30–45 minutes): item clarification; exchange and discussion of ideas;
- Step 5 (15 minutes): selection of five items per issue examined personally regarded by each participant as most important; listing of these items in order of priority, where 1 = least important and 5 = most important; writing of each item and its priority on separate 'voting ballots';
- Step 6 (30 minutes): count 'votes' and note the priority of individual items; compile a master list of all items regarded by participants as important;
- Step 7 (10 minutes): presentation of results and priorities of items; brief discussion of the master list of items; conclusion.

In Step 6, two persons not participating in the nominal group interviews compiled a list of all the items voted for by the individual group members and recorded the priority score allocated to each of these items in a data sheet. The listed items then received a total score based on the their prioritising by the participants. Eventually, six sets of items were analysed, representing feedback from each of the three groups on the two issues under consideration.

RESULTS

The results obtained by means of direct observation of the play process and the NGT are presented separately.

Direct observation of the play process

Feedback obtained from the observers was mostly positive (see Beylefeld & Struwig, 2007). Students' participation in the play process was regarded as either more than adequate or adequate, while in all sessions, the level of competition between students was perceived as healthy. In four of the observation sessions a total lack of conflict between students was noted, while conflict occurred within normal limits in the other six sessions. In nine sessions, small group communication was spontaneous and appropriate and students found the game highly enjoyable, while in one session, small group communication was regarded as spontaneous but inappropriate, and the game appeared to be moderately enjoyable. The factual content of the game was rated as highly informative in six observation sessions, and moderately informative in four sessions. One of the observers who selected the moderately informative option, also made a question mark at the option rating the game as a waste of time with regard to instructiveness.

The open comments and recommendations proposed by the observers were:

- *The board game is an excellent instruction medium that provides the opportunity for students to think about problems, to verbalise their thoughts and to communicate freely in a non-threatening environment; the game is time-effective* (Observer 1).
- *Excellent learning opportunity; students enjoyed it ... group interaction and communication enhanced; on the whole this game should stimulate interest in the discipline and contribute to learning; excellent way of informal learning – very enjoyable; communication and medical terminology enhanced* (Observer 2).
- *The concept ... is good and obviously enjoyed by the students; the questions are however ... testing esoteric detail rather than concepts or clinically relevant*

information; were one to make the questions more relevant, this would be a fantastic vehicle for learning (Observer 3).

- *Some questions are difficult … it would be good if the game could be linked to the level of competency* (Observer 4).
- *Students battle with terminology and English; the persons who ask the questions often do not have an idea what the question or the answer means* (Observer 5).
- *Some groups participate with enthusiasm, others are somewhat inhibited; participation is much more spontaneous when observers are not nearby; a facilitator [should assist students] with correct pronunciation of species names; students are not familiar with medical terminology, for example, ototoxicity … use dictionaries as an aid; some questions are somewhat specialty-oriented* (Observer 6).

Nominal group technique (NGT)

When the members of staff who participated in the nominal group interviews were requested to terminate their introductory play session of the MMFWF board game, many of them were reluctant to stop and indicated how much they enjoyed playing the game, and how challenged they were by its content. In informal discussions afterwards, a number of participants also remarked on how little they could remember of the microbiology and infectious diseases that they had studied when they were undergraduate students.

The top five items prioritised by each groups' participants on the two issues discussed, are listed in Table 1 in descending order from the highest score obtained, that is, starting with the item regarded by the participants as most important. Table 2 lists all the additional items proposed by participants, but not prioritised in the group of top five items shown in Table 1.

Items proposed by the three groups that were similar or closely related, are shown in Table 1 in different colours. For example, in Table 1 under Issue 1, the orange text shows that all the groups regarded the promotion of communication and reasoning skills as one of the top priority strengths of the MMFWF game. From an overall perspective, the four most prominent

strengths of the game proposed by the participants are the promotion of (i) communication, with the inclusion of reasoning – orange text; (ii) group work – blue text; (iii) integration of knowledge – red text; and (iv) verbalisation and improvement of terminology – green text.

With regard to suggestions for the improvement of the game, three matters were raised by at least two of the groups, namely (i) to limit play to one or two sessions at a time (red text); (ii) to mostly focus on core knowledge (blue text); and (iii) to provide assistance during play in order to facilitate students with the play process and pronunciation of terminology (green text).

Table 1. Items listed and prioritised on the two issues discussed by the three groups of participants in nominal group interviews.

	Description of item	Score
ISSUE 1: STRENGTHS OF A PLAY APPROACH		
GROUP I	• Fun approach associated with enthusiasm will improve retention of knowledge	19
	• **Higher cognitive level of thought is stimulated by reasoning among group members**	17
	• **Promotion of structured group work, interaction, team work**	14
	• **Integration and contextualising of knowledge in module and between modules**	12
	• **Improvement of microbiological and general medical terminology**	8
GROUP II	• Self-control for student of knowledge obtained: points out shortcomings in knowledge	15
	• **Opportunity for communication and reasoning**	9
	• Lends itself to create an opportunity for practical thought/practice-directed knowledge	9
	• **Good integration of aspects of the module**	8
	• Visual presentation improves retention	8
GROUP III	• **Development and expansion of group work and dynamics**	18
	• **Verbalistion of terminology**	10
	• Relevant intellectual stimulation/play in context	10
	• **Communication skills indirectly addressed**	9
	• Does not only improve knowledge – also skills	8
ISSUE 2: SUGGESTIONS TO IMPROVE THE GAME		
GROUP I	• **Keep the focus on core knowledge: Family Medicine should assist**	19
	• Include some of the questions in formal assessment	12
	• **Play per session: develop questions to cover work done in one or two sessions**	11
	• **Employ facilitators to assist students during the play process**	10
	• **Employ aids to assist students with pronunciation of terminology**	9
GROUP II	• **More delimited (play per session)**	16
	• **Have sources available for clarification of facts and pronunciation**	13
	• Explain purpose of game clearly: fun/revision/competition/replacement of group work/stimulation?	13
	• Compile questions from text book/outcomes-based	12
	• **Feedback session necessary: teacher must clarify problems**	7
GROUP III	• **Delimit work: sessions/core knowledge/compulsory categories**	14
	• Outcomes (skills, attitudes) must be reflected – across module borders	12
	• Computerise game	11
	• Alternative to game: open book/bonus mark for using own source	11
	• Include clinical approach/application	9

Table 2. List of items in addition to the top priority items.

Items proposed but not rated as top priority
Issue 1 (strengths of a play approach)
• Valuable hints for improvement of other modules
• Self-evaluation: points out shortcomings in knowledge*
• Covers a broad area of subject knowledge
• Promotes retention of knowledge*
• Non-threatening evaluation opportunity*
• Promotes self-confidence in students
• Pleasant learning process*
• New development: moves away from traditional
• Response/knowledge tested against standardised memo
• Assurance that core knowledge has been covered
• Relevant intellectual stimulation*
• Learn without official assessment
• Expand concept to other areas of study
• Both person who asks question and one who answers involved in learning process; learn by teaching
• Ownership of learning process cultivated in student
• Challenging and stimulating play style and reward
• Facilitator does not need to have knowledge of the subject
• Classification of questions promotes organisation of subject knowledge
• Testing on field of study/integration
Issue 2 (suggestions for improvement)
• Compile a bilingual version of the game
• Add more questions on surgical infections
• Update continuously
• Time limit/very time-intensive; balance between time and maximum learning
• Student assignment: self-formulation of questions
• Two sets: basic knowledge and advanced knowledge
• Groups not too big, e.g. 3–4 per team
• Make a concise version
• Build in levels of difficulty – reward system accordingly
• Different versions with time limits
• Use the same group as for other activities (bonding)
• Structure in such a way that all categories are covered
• Marketing of the concept
• Do not limit to core knowledge
• Do not separate difficult and easy questions

*Items marked with an asterisk occurred in more than one group or have been prioritised (see Table 1).

DISCUSSION

From the feedback received from participants in both the direct observation of the play process and the nominal group interviews, it was clear that members of staff in the School of Medicine mostly had a positive perception of the MMFWF board game. In addition to their approval of the game in principle, meaningful and practically applicable comments and recommendations were made.

None of the criteria on the evaluation of the play process by means of observation was rated in the worst/most negative category (see Exhibit 1), with the exception of one observer who indirectly queried the instructiveness of the game's content. This observer also remarked on students' battle with terminology and therefore their potential lack of understanding the meaning of some of the questions or answers included in the board game. It was also troublesome to hear from some observers that the questions will be too difficult. They added that some students had problems with pronouncing the names of microorganisms. According to the same observer, students do not even know the meaning of basic terms such as *ototoxicity*. These observations were disconcerting, but also confirmed the usefulness of the MMFWF board game while students are busy with the Infections module. Their inability to correctly pronounce the names of organism and other medical terms, could be attributed to a lack of verbally expressing themselves in subject-specific language. It is a matter of concern that students who had already completed the Infections module and were in their third year of medical studies, had trouble verbalising the knowledge acquired in the module.

It cannot be denied that the MMFWF board game contains topics that could be regarded as too advanced for the students' level of training. However, a subtle balance had to be found when the databank of questions and answers was compiled. With the assistance of a specialist qualified and experienced in clinical pathology, virology, medical microbiology and infectious diseases, the questions in the databank were classified as either basic or advanced knowledge, with 56% of the 700 questions included in the game regarded as basic and the remainder as advanced. The dispute regarding the advanced level and difficulty of questions included in the game, is reminiscent of the delicate balance between challenge and skills addressed by

Csikszentmihalyi (1996, 2002) in his flow theory of optimal experience. According to the flow theory, *apathy* is most likely to be observed when a low level of challenge is presented to an individual with a low level of skills, while *boredom* is most likely to occur when a low level of challenge is presented to an individual with a high level of skills. *Anxiety* will almost invariably be experienced when a person with a low level of skills is confronted with a high level of challenge. The ideal condition of *flow* is experienced when a situation posing a high level of challenge is met by a high level of skills, and facing the challenge results in exploring new skills, if necessary (Csikszentmihalyi 1996, 2002).

It could thus be argued that in order to satisfy the challenge-versus-skills needs of all participants involved in playing the game, it is to be expected that a certain number of questions will inevitably be regarded as too advanced. The academically strong and intrinsically motivated medical student will approach these questions as a challenge and not as threatening or frustrating. Consequently, he/she will experience fulfillment and satisfaction when the challenge is dealt with successfully, even though a demanding process of developing and applying new skills may be required. On the other hand, some students may experience anxiety when confronted with the advanced questions, while stronger students may experience boredom when the basic questions are not seen as a challenge to their level of skills (Csikszentmihalyi, 1996, 2002).

The remark by Observer 3 that the game is testing *esoteric knowledge* can be counter-argued by a point of view similar to the one relating to some questions being regarded as too advanced. One of the most fundamental problems encountered when compiling the databank of questions and answers, was that the information available in the form of study notes provided for the Infections module representing core knowledge, would not have been sufficient to put together a databank of such a comprehensive scope (although students regard the volume of work covered in the module as 'too much'). The MMFWF board game contains 100 questions in each of six basic categories of medical microbiology, namely bacteriology, virology, mycology, parasitology, and diagnosis and treatment of infectious diseases, as well as an additional 100 questions in the category general medicine (Struwig et al., 2005). Substantially fewer questions would have been included in the game if the study notes had

been used exclusively as the source of information, again pointing towards the challenge-versus-skills argument. Furthermore, it can be expected that some students as well as observers of the play process will judge certain topics as esoteric and not clinically relevant. By the time the Infectious module is presented in the undergraduate medical curriculum, students have not been exposed to patients in clinical settings, and many questions with a focus on the clinical aspects of infectious diseases may in fact be seen as only of theoretical value. Despite these points of critique, this particular observer also referred to the game as potentially being 'a fantastic vehicle for learning'.

A further explanation for the seemingly too advanced and obscure nature of some of the questions and answers included in the MMFWF board game, is of a much more personal nature. At the time of producing MMFWF, the designer and developer of the game (the researcher) was convinced that medical students would find the questions stimulating and challenging, regardless of the level of difficulty. She believed that students, when confronted with a totally unfamiliar concept not necessarily dealt with in the Infections module, would be motivated and driven by curiosity to obtain more information on this newly encountered topic. Since medicine is a field of study that requires exceptional abilities and poses extraordinary challenges to its pursuers, this conviction was based on the generally-accepted notion that medical students are selected from the *crème de la crème* of scholastic achievers (Achike & Ogle, 2000:177), thus from among the very best in their peer group with regard to intellectual and academic competence. In this vein, Carroll (2003:946) contemplates in his article on the relevance of basic science learning objectives to clinical practice. He asks whether a five-year medical curriculum is *merely a training for clinical practice, or should it be seen in a wider context of a university education?* Likewise, as argued by Ramsden (2010:s.p.), *a university education is nothing if it does not fire up a burning desire to learn*.

Interestingly, according to the students' feedback obtained by means of a questionnaire survey shortly after playing the game on three consecutive occasions, 79% of the participants were of the opinion that the questions were not too difficult in general (unpublished data). The open-ended question *Do you think the questions were too difficult in general?* elicited positive remarks such as:

- *Yes, but that is how it should be so that we can learn something from it.*
- *Difficult or not: questions can still be put in, otherwise what sense does it make to learn only the easy stuff.*
- *It was difficult because it was new to me at first but eventually I enjoyed it.*
- *The difficult ones brought more challenge and made it even more fun between team mates.*
- *Some questions were difficult to answer only because we hadn't done the work yet. The more one plays, the more you'll know and the easier the game will be.*
- *There were a few questions we didn't know, but it made it more interesting to learn new things too, rather than just revise what we have learnt.*
- *They were fairly reasonable and besides, the aim of these questions is to improve our knowledge.*

Keeping the content of the curriculum focused on core knowledge (Harden, 2001) in order to prevent information overload and burdening students with clinically less important knowledge, is a daunting task for most members of academic staff involved in medical students' training. In a vast and complicated field such as medical microbiology and infectious diseases, this challenge can become particularly overwhelming. With reference to the remark made previously regarding the amount of information in the Infections module being too limited for exclusive use in the MMFWF game, the inclusion of questions on topics regarded as too advanced by some of its critics may be justified.

It should also be kept in mind that clinical teachers have their own perspective with regard to the importance and relevance of certain aspects of the basic sciences. Carroll (2003:946) argues that clinical teachers may fail to appreciate that in the first two years of studying medicine, *core concepts… contribute to a cognitive framework that facilitates understanding* of related aspects presented at different or even later stages of training. With regard to the relevance of basic science content included in the curriculum, it is easier said than done to strike the right balance between short- and long-term learning outcomes (Carroll, 2003).

The observation that small group communication spontaneously took place in 90% of the sessions observed, is supported by previously reported findings. Beylefeld and Struwig (2007) found that before playing the game, 32% of students (n=109) were of the opinion that the Infections module was suitable for small group learning, as opposed to 99% (n=100) who indicated that spontaneous group discussion occurred while playing MMFWF; and 95% who reported having exchanged factual knowledge with fellow students during play. The nominal group participants similarly rated the promotion of group dynamics, the exchange of knowledge and interactive reasoning among the top priority strengths of the game (see Table 1). The view of 90% of students who indicated in their evaluation of the game that playing MMFWF was great fun (Beylefeld & Struwig, 2007) is echoed by 90% of observation sessions in which the game was reported by observers as highly enjoyable.

According to the observers, only 60% of observation sessions depicted the game as highly informative. However, in the questionnaire survey conducted after playing the game, 99% (n=100) of students said that MMFWF made them realise that they still had a lot to learn about medical microbiology, and 84% indicated that they had obtained quite a lot of new knowledge during the play process (Struwig et al., 2005). The discrepancy between the views of students and staff could be explained by the fact that the observers were not actively involved in the play process, and the students were in a better position to compare their existing knowledge acquired in the Infections module with additional information provided by the game.

The results obtained by means of the NGT, as well as participants' gratifying response when their brief play session was declared over, confirmed that these members of staff had a positive experience of the MMFWF board game. With regard to the first issue presented, investigating the potential strengths of a play approach in the development and promotion of subject-specific factual knowledge and general skills, one of the highest scores was allocated to the item proposing that the fun approach associated with enthusiasm will improve retention of knowledge (see Table 1). Although proposed by only one of the nominal groups, this point of view strongly links up with the observers' feedback on the game as highly enjoyable. Once again, this finding relates strongly to students' evaluation of MMFWF. Ninety-five percent of them (n=109) agreed that play in general could be applied as a meaningful learning

opportunity (Struwig et al., 2005), while 73% indicated that they felt more enthusiastic about medical microbiology after playing the game (Beylefeld & Struwig, 2007).

As early as 1933, Dewey (cited by Rathunde & Csikszentmihalyi, 1993) suggested that the ideal mental condition for learning to take place to an optimal extent requires being playful and serious at the same time. Enthusiasm, as an emotional experience, cannot be isolated from concepts such as hope, positive feelings and emotions, optimism, and the belief that goals and objectives will be achieved (Goleman, 1995). Games and simulations, regarded as experience-based or experiential instructional methods, involve more complex and diverse approaches to learning processes and outcomes. According to Ruben (1999), they promote interactivity, collaboration and peer learning, allow for addressing cognitive as well as affective learning issues, and, perhaps most important, foster active learning.

While some the observers of the play process were concerned about students battling with terminology and the pronunciation of the names of microorganisms, the participants in the nominal group interviews were of the opinion that playing MMFWF would provide students with the opportunity to verbally express themselves, using microbiological and general medical terminology (see Table 1). In two of the three groups, this particular strength of the game was listed among the top priority items. Accordingly, in the students' evaluation of the game, 97% were of the opinion that MMFWF would help students to present their knowledge of medical microbiology verbally (Struwig et al., 2005).

With reference to Rogers' diffusion of innovation theory (Scott et al., 2008), the MMFWF board game in principle fulfils the five criteria required for an innovation to be accepted. The first characteristic, relative advantage – that is, the degree to which an innovation is perceived as being an improvement on the product, method or approach it will replace – however, demands further comment. The MMFWF board game was not developed with the intention to supersede the current approach to teaching in the Infections module, which at the time of the study focused primarily on formal lectures. The game's fundamental purpose was to be used as a supplementary learning tool to expose students to the subject content in a relaxed, non-threatening atmosphere, while participating and enjoying healthy competition in a small group

context. Results from the students' evaluation of the game, the observation of play and the nominal group interviews, support the argument that by fulfilling the rest of the criteria of Rogers' theory – compatibility, complexity, trialability and observability – the MMFWF board game has the potential to be employed as a complementary group work instrument.

CONCLUDING REMARKS

The feedback received from the observers of the play process as well as the nominal group participants should serve as guidance for the future improvement of the MMFWF board game. The NGT was employed successfully to investigate a group of individuals' personal opinions on an issue, while at the same time receiving constructive comments and recommendations for the improvement of the product under investigation. The observation instrument provided responses from the play observers that should also be taken into serious consideration when an updated version of the game is planned.

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ARTICLE IV

THE COMORBIDITY OF CONTENT OVERLOAD, POOR MOTIVATION, SURFACE LEARNING, SUBOPTIMAL RETENTION OF KNOWLEDGE, AND A ZEIGARNIK-LIKE EFFECT IN UNDERGRADUATE MEDICAL MICROBIOLOGY: WHAT IS THE PROGNOSIS?

THE COMORBIDITY OF CONTENT OVERLOAD, POOR MOTIVATION, SURFACE LEARNING, SUBOPTIMAL RETENTION OF KNOWLEDGE, AND A ZEIGARNIK-LIKE EFFECT IN UNDERGRADUATE MEDICAL MICROBIOLOGY: WHAT IS THE PROGNOSIS?

ABSTRACT

The discipline of microbiology and infectious diseases presents a serious challenge to medical students, mostly due to its extensive content and complexity of new terminology such as the names of numerous clinically relevant microorganisms, and other intricate subject-related concepts. It is therefore not surprising that when students experience so-called information overload – which is not restricted to medical microbiology – they revert to performance goals and the wrong motivation for learning. Their focus then primarily turns to being successful in tests and examinations, and consequently adopting a surface approach to learning. Surface learning and memorisation of facts without understanding its content usually result in poor retention of knowledge, which could eventually handicap the development of clinical reasoning in the process of preparing for medical practice. This paper reports findings on medical students' motivation for and approach to learning in the Infections module of their undergraduate medical curriculum, and their experience of a lack of retention of knowledge acquired in the module, as determined by a self-administered, anonymous questionnaire. From findings published in the literature, the concern regarding students' poor retention of knowledge can be laid to rest. The prognosis is not so poor after all.

INTRODUCTION

Knowledge is a burden if it does not bring you joy.

Sri Sri Ravi Shankar (1956 –)

Since Abraham Flexner's revolutionary report on medical education in the United States of America and Canada, submitted in 1910 to the Carnegie Foundation for the Advancement of Teaching (Flexner, 1910), it has been widely advocated that basic science should be covered over a period of at least two years of early medical training. Furthermore, it has been proposed that a sturdy foundation in basic science should serve as a prerequisite for competent medical practice (Doheny, 2010; Woods, Neville, Levinson, Howey, Oczkowski & Norman, 2006; Spencer, Brosenitsch, Levine & Kanter, 2008). Although not always clearly noticeable, the basic sciences do not lose their relevance in either the clinical years of medical training or postgraduate studies when specialising in a specific discipline (Leslie, 2001). Woods et al. (2006) were able to provide evidence that a solid understanding of basic science could be regarded as a major contributory factor to clinical reasoning and diagnostic proficiency. They argue that *students who learn basic science explanations for clinical conditions, will be better able to remember the critical features of these conditions after a delay period, than a control group of students who simply learn the features of the condition* (Woods et al., 2006:S125).

In response to the constant increase in medical and scientific information, educators tend to expand the content of their lectures, resulting in overstuffed courses and insufficient time to cover the subject matter that actually deserves attention (Dalley, Candela & Benzel-Lindley, 2008). The upsurge of information has made mastery of the basic science disciplines almost impossible to achieve. Mastery is not determined by the quantity of information being assimilated. Of crucial importance, is the ability to organise and incorporate basic science and clinical knowledge into a functional complex of schemata, concepts and facts (Suter, Mandin & Small, 1998).

LITERATURE OVERVIEW

More than 30 years ago, in 1978, Harold Neu asserted that the primary objectives of training students in medical microbiology and infectious diseases were not successfully fulfilled, which he attributed to the large volume of subject information that students had to master. He did not believe that it was possible for medical students to integrate the intricate assortment of information they were presented with in their microbiology courses. According to Neu (1978:818–9), the major objectives of training in medical microbiology and facts that medical students should learn about in their infections diseases course, included the following and are still applicable today[1] (Appendix E):

Major objectives

- foundation in cell biology;
- understanding of basic host-microbe interactions;
- understanding of relevant medical microbiology;
- understanding of the principles of antimicrobial therapy;

Facts that students should learn

- the characteristic clinical presentation of a disease;
- who gets the disease;
- which organisms are usually involved;
- diagnostic procedures that will aid the diagnosis;
- the cost-benefit aspects of diagnosis and therapy; and
- how a specific disease can be prevented.

Early in 2010, the Infectious Diseases Society of America (IDSA) Preclinical Curriculum Committee published a paper in which the authors assert that in order to cover large amounts

[1] In general, these objectives are still relevant as demonstrated by the aims of the Infections module presented in the second year of undergraduate medical training in the School of Medicine, University of the Free State, Bloemfontein. The aim of the Infections module is *to supply the second-year medical student with core knowledge regarding clinically relevant microorganisms (bacteria, viruses, fungi and parasites) and their role in infectious diseases. Furthermore, the student will obtain knowledge with regard to the diagnosis, treatment, prevention and control of infectious diseases, the implications of resistance to antimicrobial agents and the basic mechanisms of pathogenicity* (Infections Module Guide, Department of Medical Microbiology, Faculty of Health Sciences, University of the Free State; see Appendix E).

of information, lecturers resort to PowerPoint presentations afterwards *reproduced as notes, with the understanding that students will only be responsible for the facts included in these documents* (Southwick, Katona, Kauffman, Monroe, Pirofski, del Rio, Gallis & Dismukes, 2010:19). Such an approach to presenting the subject content results in students' experience of medical microbiology as *overwhelming and unappealing* (Southwick et al, 2010:19). DiCarlo (2009) confirms that being exposed to huge amounts of subject content presented primarily by means of formal lectures, is not conducive to active learning. He argues that the lecturer *assumes the responsibility for presenting a common body of knowledge to all students, and the students assume the responsibility of repeating it on demand* (DiCarlo, 2009:259).

In their paper *Too much teaching, not enough learning: what is the solution?*, Lujan and DiCarlo (2006:17) provide their readers with a scenario that perhaps sounds uncomfortably familiar when they ask,

> *How often has a colleague, from an upper-division course, inquired if you have covered a specific topic in your class? Your colleague was concerned because the students in his/her class (a class after yours) acted as if they never heard of the topic. Or, how often have you just completed a series of lectures on a subject only to encounter students who were unable to discuss even the simplest concepts you have covered?*

They continue to argue that students often memorise the content of their subjects and pass examinations without really understanding what they have learnt. Lujan and DiCarlo (2006) further explain that memorisation occurs when the student does not put in sufficient effort – or any effort at all – to make a logical connection between new material and existing knowledge or newly experienced situations. In their study on approaches to learning in the biological sciences, Watters and Watters (2007) report that most students involved in their investigation acknowledged that they used study techniques and strategies that emphasised memorisation of factual content by repetition.

Newble and Cannon (1995:152–153) proposed three approaches to learning that are closely related to students' motivation and purpose for study. These approaches include *surface learning*, which involves rote learning with little understanding and the student relying on memorisation of factual content to reproduce what has been learnt, while a superficial level of understanding is attained; *deep learning*, which involves an active search for meaning in an attempt to understand what is learnt; and *strategic learning*, where the learner is motivated by achievement of a specific goal and adopts a strategy to achieve the goal.

Roger Säljö (1979) classified different views on learning into five categories, of which Atherton (2010) presents a brief summary. Säljö's first three categories comprise learning that primarily aims to obtain a quantitative increase in knowledge and facts that can be memorised, and represent approaches underpinning surface learning strategies. The other two categories characterise deep learning strategies that focus on making sense of knowledge by relating parts of the subject matter to each other and the real world, and interpreting and understanding reality from a new or different point of view (Atherton 2010). The student is thus successful in connecting concepts to evidence, integrating information across disciplines, recognising general principles (McManus, 2001:383), and using evidence critically (Reid, Duvall & Evans, 2007). When driven by mastery as the primary objective of learning, deep learners tend to experience positive affect, make use of flexible and adaptive learning strategies, and on a cognitive level, become intensely absorbed in the information being studied. They will also approach difficult problems with persistence and learn from their mistakes (Seifert, 2004).

When using a surface learning approach, the student is primarily motivated by his/her goal to complete the course, and fear of failure often plays a prominent role (Newble & Cannon, 1995). From a different perspective, fear occupies a positive position in the learning process: without fearing the negative consequences of failing, students might neglect the studying required to obtain a passing grade (Borich, 1996). However, when a student's ultimate goal is to obtain his/her degree – only so that he/she can register with a specific health professions authority and practice as a medical doctor – his/her entire undergraduate course will inevitably consist of numerous intermediary goals in the form of tests and examinations that need to be

passed to complete a specific module. Such a one-dimensional motivation for learning – to pass tests and examinations – inevitably leads to surface learning.

In addition to rote learning as the key element of surface learning, the student focuses on isolated components of the work. A surface learner hardly experiences any real interest in the material that has to be studied (McManus, 2001). Such an approach will eventually handicap his/her ability to integrate and relate the information from that specific component of the work to other aspects of the subject, and different medical disciplines in general. Furthermore, argues Bandaranayake (2001), surface learning mostly results in short-term retention of the knowledge acquired.

Students who apply a strategic approach to learning are usually driven to obtain high marks, are competitive and need to be successful (Newble & Cannon, 1995). Although strategic learners typically employ study techniques that will ensure the achievement of good marks, their level of insight into the material studied is often inconsistent and unreliable (McManus, 2001:383). A learning pattern focused on failure avoidance does not fully process and integrate information acquired by means of a strategic learning approach (Seifert, 2004). Reid et al. (2007:754) point out that deep and strategic approaches to learning *are not mutually exclusive and [a student] may switch between them*.

Students' approaches to learning are also influenced by their specific achievement goals. These goals include (i) mastery goals, which specifically focus on the development and mastery of skills and knowledge; and (ii) performance goals, characterised by the primary objective to demonstrate ability, usually in relation to others (Ames, 1992). Dweck and Leggett (1988) argue that students driven by mastery goals do not perceive a difficult task in terms of possible failure, but rather as an opportunity for learning and mastery. On the contrary, students with performance goals feel threatened by possible failure when facing a difficult task. Students' affective response to these achievement goals differ in the sense that performance goals often result in worry, anxiety and depression, while students with mastery goals experience less negative affect. They rather feel challenged, due to the absence of feeling threatened and the fear of failure commonly associated with difficult problems (Dweck & Leggett, 1988). It has

further been found that the decreased negative affect experienced by students with mastery goals, improves working memory function, and thus plays an important role in these students' cognitive functioning and their ability to employ adaptive cognitive strategies (Linnenbrink, Ryan & Pintrich, 1999).

To become fully engaged in the learning process requires consistently positive emotional experiences, and emotion, motivation and cognition are strongly interrelated (Meyer & Turner, 2006). Students' behaviour regarding their approaches to learning is influenced by their emotional response to the task at hand (Seifert, 2004). At the same time, they have many reasons to believe that rote learning is the only or the best way to master the work they have to know for assessment. As Lujan and DiCarlo (2006:17) aptly state, *the curriculum is packed with so much content that, to "cover the content", … students simply commit facts to memory.* This view had been expressed decades before by Marton (1976) and Marton and Säljö (1976), and reiterated more recently by Biggs and Tang (2007). Mattick and Knight (2007) argue that students' perceptions of the learning and assessment environment determine to a great extent the approach to learning that is adopted. Consequently, when students experience a combination of content overload and the belief that rote learning is the best way to commit knowledge to memory, surface learning will be encouraged. The perceived volume of subject content may cause severe anxiety, and many students are not able to establish what should be regarded as an appropriate depth of knowledge (Mattick & Knight, 2007). Although it is important for doctors to be thoroughly equipped with a solid scientific underpinning to practice medicine (Pawlina, 2009), both Harden (2001) and Grande (2009) recommend that basic science staff must accept that it is unattainable to teach medical students all the factual information required to carry out their professional duties, and should guard against striving to do so.

Guilbert (cited by Guilbert, 1998:67) introduced the concept of coveritis, which he explained is a *strong belief or propensity, conscious or unconscious, held by a teacher (or a student), leading to the overwhelming desire to cover a subject exhaustively or comprehensively during an academic course.* He quoted a student who had expressed his concern that *this PBL [problem-based learning] reform… might leave holes in my theoretical and practical*

knowledge, while the present programme is very systematic and covers (I hope) all the knowledge that I need to know (Guilbert, 1998:67). One can understand this student's apprehension, since undergraduate students are by far not mature enough, nor do they have the experience, to judge for themselves which information might be most relevant for the clinical practice of medicine (Guilbert, 2001).

Coveritis, also referred to by Guilbert (1998:69) as *an acute and chronic faculty disease*, may thus be proposed as an explanation for – even the cause of – many students' attempt to master huge amounts of information by means of memorisation. Apart from a lack of deep understanding, contextual consolidation and integration of the new knowledge acquired, another major consequence of such an approach to learning is suboptimal and often nothing less than poor retention of knowledge (Bandaranayake, 2001). This chain of events can be illustrated by the diagramme presented in Figure 1.

In an effort to cover the content, lectures are commonly preferred as the mode of instruction. It is accepted that lectures do facilitate the sharing of information with a large number of students and are regarded as an effective way of conveying factual information. However, a lecture merely exposes students passively to the information, which is not sufficient for learning (Lujan & DiCarlo, 2006) and further promotes rote learning. Several studies (for example, Cherney, 2008; Costa, Van Rensburg & Rushton, 2007) report evidence that undergraduate medical students value interactive learning as opposed to passively listening to a lecture, and prefer the use of various teaching modalities to accommodate different learning styles, and also that such an approach to teaching promotes better retention of knowledge.

A lack of retention of knowledge by students who have completed a module or a course, is not an uncommon occurrence (Grande, 2009; Greb, Brennan, McParlane, Page & Bridge, 2009; Lazić, Dujmović & Hren, 2006; Ling, Swanson, Holtzman & Bucak, 2008; Southwick, 2007; Vadivelu, 2008). In a recent study by Mateen and D'Eon (2008), a group of graduating medical students sat for a multiple-choice test which had been written approximately three years earlier in their first-year neuroanatomy module. They were not given any warning in advance and the test was written completely unprepared. The relative knowledge loss

observed in this group was substantial, with the mean test score decreasing from 82% to 33%. Only two out of 24 students (8.3%) passed the surprise follow-up test with 50% and 55%, respectively, while the rest failed. The authors argue that a majority of students will eventually forget not only esoteric, but also clinically relevant knowledge. It is thus imperative for both teachers and students to be able to differentiate between excessive minutiae and information that is worth remembering (Mateen & D'Eon, 2008:538).

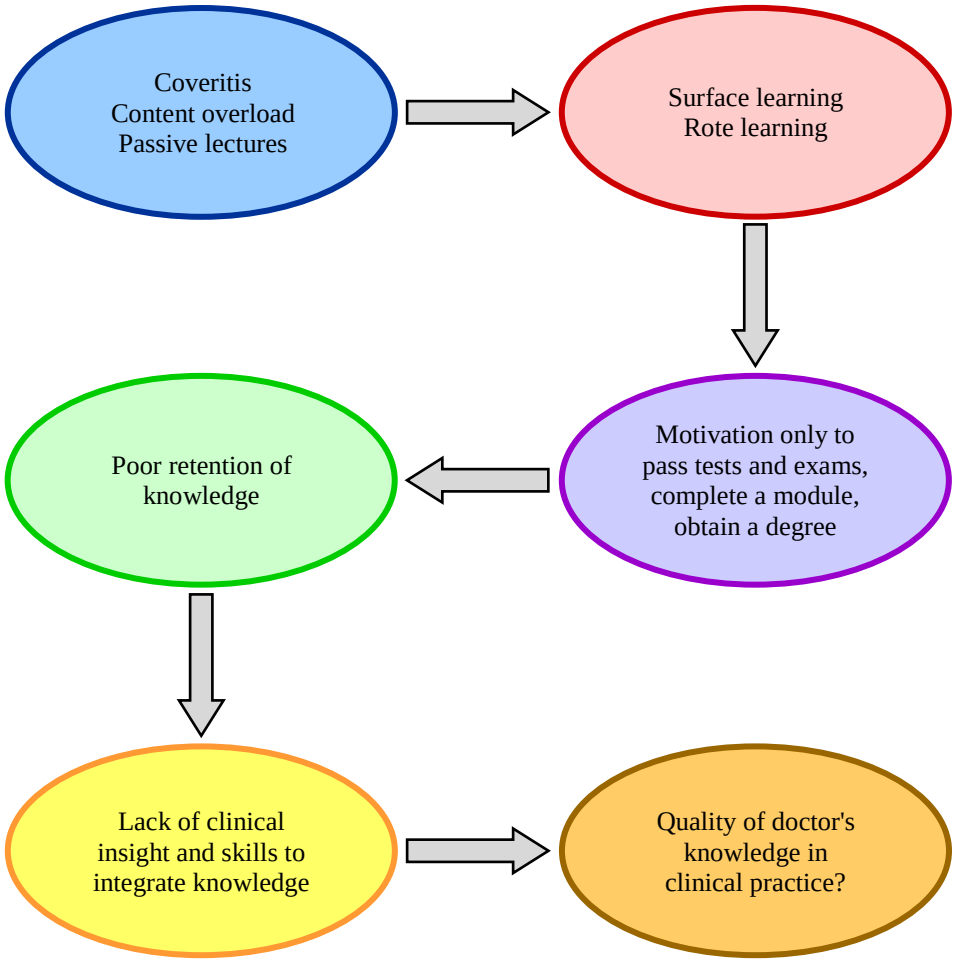

Figure 1. The chain of events that may ensue when medical students are overwhelmed by content overload and resort to surface learning.

In a study investigating senior medical students' retention of basic science information (Ling et al., 2008), the largest decline in knowledge over a two-year period was measured in biochemistry, microbiology and pharmacology. Scores obtained in these three disciplines decreased with 17.5%, 12.6% and 10.1%, respectively. The authors noted that they expected

different patterns of retention due to increasing emphasis on clinically relevant basic science information in teaching and the inclusion of its assessment in a clinical context (Ling et al., 2008), which was proven by their results as an unfounded expectation.

Southwick (2007) reported that he was taken aback when he discovered how much microbiology knowledge a group of fourth-year medical students had lost over a two-year period. From the total group of 30 students he had tutored previously, not one could remember any of the cases he had discussed with them during their second year of study. He was further astounded when it became apparent that many of the students failed to recall the key points of his lectures, and struggled to apply their basic science knowledge to clinical practice. From his experience, Southwick (2007:116) remarked that these students were *suffering from the Zeigarnik effect*.

According to the Merrian-Webster Online Dictionary (Merrian-Webster, s.a.), the Zeigarnik effect is defined as *the psychological tendency to remember an uncompleted task rather than a completed one*, while Site (2009:s.p.) gives the following explanation:

> *Short-term memory can be temporarily crammed with blocks of material that allow the student to [provide] the correct answer. However, once the test is completed these facts are erased and never make it to long-term storage. This phenomenon has been called the Zeigarnik effect.*

The Russian psychologist, Bluma Zeigarnik, obtained international esteem in 1927 with the publication of her article *Das Behalten erledigter und unerledigter Handlungen (On remembering completed and uncompleted tasks).* Based on her observations, she reported that interrupted tasks are remembered by adults approximately 90% better than tasks fully completed, and that children, in general, remember only interrupted tasks. Completed tasks enjoy lower priority, as they have been already been removed from the list of things that need to be done. The Zeigarnik effect is nowadays commonly known in fields such as psychology and advertising (Zeigarnik, 2007). It could be argued that the successful completion of a module in a curriculum might result in a similar outcome, and that the retention of knowledge

after completion of the module could be influenced by a Zeigarnik-like effect. A detrimental combination of factors that could seriously impair a student's retention of knowledge is produced when a Zeigarnik-like effect occurs in conjunction with the wrong motivation for and approach to learning, negative affect towards the subject, and feeling overwhelmed by its volume and complexity.

AIM OF THE STUDY

With this paper, the authors aim to provide evidence with regard to the Infections module presented in the second academic year of the MBChB curriculum in the School of Medicine, Faculty of Health Sciences, at the University of the Free State (UFS), that:

- students' motivation for learning does not always promote deep learning and understanding of the subject content;
- as a result of feeling overwhelmed by the volume of the factual content, a substantial number of medical students resort to surface learning in microbiology and infectious diseases;
- higher learning skills are not applied optimally in students' learning of the subject; and
- by the beginning of their third year of study, students experience reduced retention of knowledge in a short period of time following completion of the Infections module.

Furthermore, the authors will attempt to deduce from the research findings the severity of the situation among this group of medical students included in the study. We will then make an informed conclusion regarding the long-term prospects – the prognosis – of this intricate variety of factors contributing to poor retention of knowledge.

METHODS

A descriptive, explorative study investigating the introduction of a medical microbiology board game, Med Micro Fun With Facts (MMFWF), was conducted. With regard to the study design and methodology, a qualitative research approach was followed and included a

combination of design-based research (Barab & Squire, 2004; Hoadley, 2004), naturalistic evaluation (De Vos, 2002; Patton, 1990), and a qualitative case study (Donmoyer & Galloway, 2010; Simons, 2009; Stake, 1995). The MMFWF board game was designed and developed by the principal author (MCS) in an attempt to transform medical students' negative perceptions of and attitudes towards medical microbiology, and to expose them to the subject's factual content by means of an interactive, student-centred learning approach (Struwig, Beylefeld & Hugo, 2005).

Participants in the study were third-year medical students who had successfully completed the Infections module by the end of the previous semester (that is, by the end of their second academic year). The MMFWF board game was purposefully introduced to them after completion of the Infections module in order to get their retrospective opinions on the module, and their views on the usefulness of the board game to supplement module content and delivery. In this particular case, a retrospective opinion was regarded as potentially more valuable because students would presumably not feel pressurised or threatened by the process as they had already completed the module (Struwig et al., 2005). It was anticipated that exposure to the game during relaxed, interactive sessions, without the intimidating prospect of a test or examination being associated with the learning process, would result in candid critique and recommendations.

The students completed two separate self-administered questionnaires: Questionnaire I before the introduction of the game, and Questionnaire II directly after they had played the game in small groups on a weekly basis for three consecutive weeks (Struwig et al., 2005). In order to match the two questionnaires, each participant used the same self-selected code on both questionnaires. Participation was voluntary and anonymous, and all information was regarded as confidential. Participants had the choice to withdraw from the study at any point without having to give reasons or being penalised.

Questionnaire I was adapted with permission from Du Toit (1999). Based on information obtained from the literature, additional items applicable to the research were included. Both questionnaires consisted of items evaluated on a 5-point Likert scale. Aspects investigated

included (i) students' perception of and attitude towards medical microbiology; (ii) their reasons for and approach to learning the content of the Infections module; (iii) their opinion regarding the volume of work and retention of knowledge; (iv) their experience of the MMFWF game as a potential learning modality in the Infections module; and (v) the effect of the game on their perception of medical microbiology (Struwig et al., 2005). Open-ended questions were also included in both questionnaires.

For the purpose of this article, analysis was done only of those questionnaire items dealing with student's (i) motivation for learning; (ii) approach to learning; (iii) application of higher learning skills, such as making a conscious attempt to understand and integrate the subject content; (iv) opinion on the volume of information covered in both the Infections module and the board game's questions-and-answers databank; and (v) opinion on their level of retention of knowledge. A limitation of the study was that retention of knowledge was not quantitatively evaluated by means of a follow-up test similar to the investigations described in other reports (Ling et al., 2008; Mateen & D'Eon, 2008).

In order to corroborate the questionnaire findings, semi-structured focus group interviews (Greeff, 2002) with stratified, randomly selected students from this particular third-year class (n=108)[2], were conducted after the introductory phase of the MMFWF board game. The stratified groups from which participants were selected by means of a random numbers table, are shown in Figure 2. Two students were selected from each group representing the different levels of achievement in the Infections module. High achievers obtained a final mark of 70% or more in the module, intermediate achievers obtained from 60% to 69%, and low achievers from 50% to 59%. Twelve students from both Afrikaans and English classes, six male and six female in each language group, participated in the focus group interviews. The Afrikaans and English interviews were conducted separately, facilitated by the same person.

[2] By the time the participants for the focus group interviews were selected, one of the students who had completed Questionnaire I and participated in the introduction of the game, did not pass a supplementary examination and thus returned to the second year.

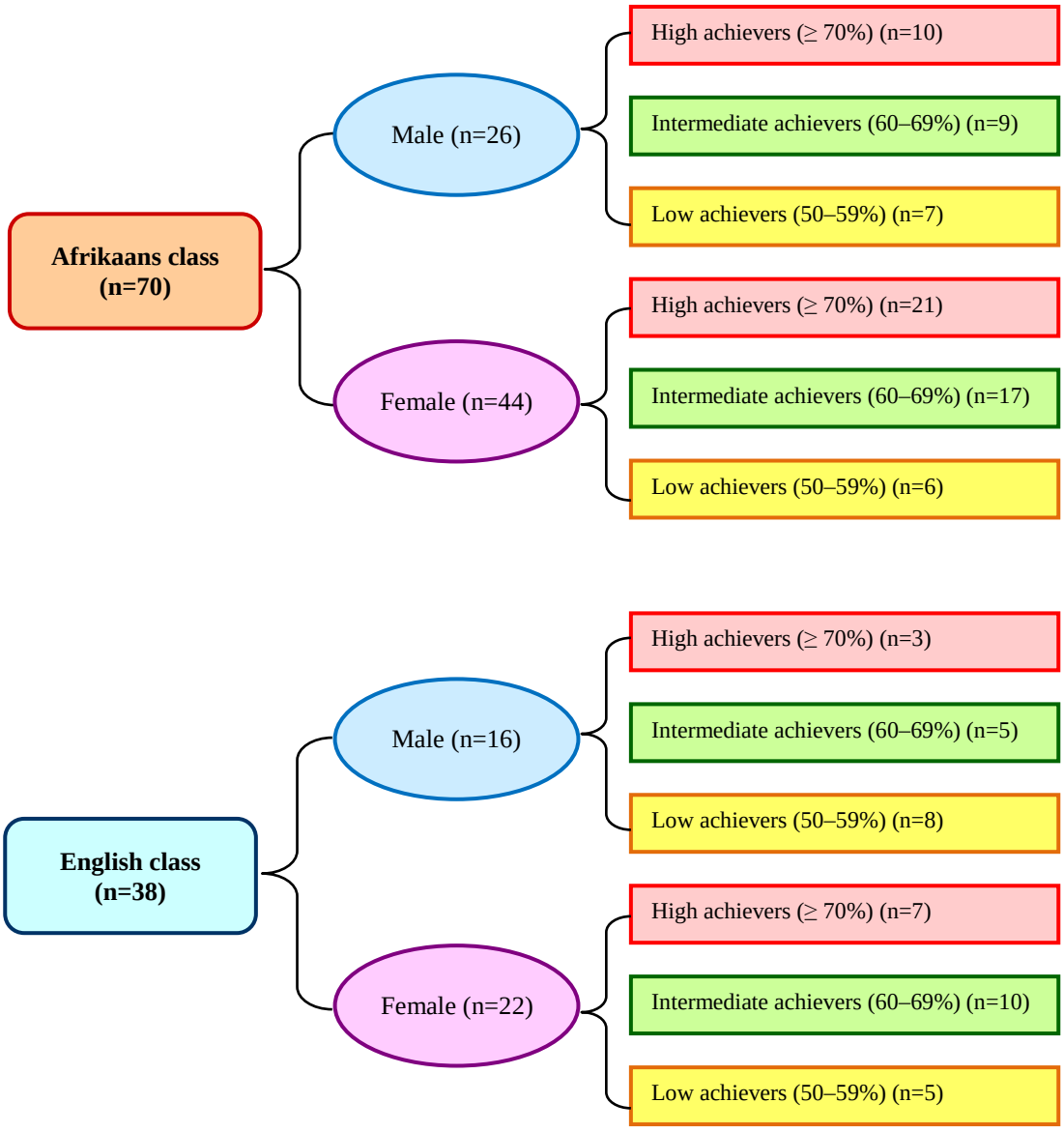

Figure 2. Stratified groups from which participants for the semi-structured focus group interviews were randomly selected.

The interviews were recorded by means of audio equipment. Recordings, lasting approximately 70–80 minutes, were transcribed verbatim and content analysis of the transcripts was performed to identify themes and data points. Data were coded as propositional coding units; in other words, contextual overtones were taken into consideration (Cumbie & Sankar, 2010:159), rather than doing word frequency counts. A propositional coding unit

represents a more substantive involvement and insight than word frequency counts, which often deprive the coder of engaging with the content at a deeper level (Stemler, cited by Cumbie & Sankar, 2010).

Prompts presented to the participants to elicit dialogue were based on Questionnaire I and II findings, and are listed below. Open-ended statements were used as prompts to allow participants to respond in their own terms, sharing points of view and perceptions without the pressure of voting or reaching consensus (Greeff, 2002). Purposefully selected interview results which focus mostly on students' feedback on Prompts 1 and 2, are presented in this paper, as these two prompts can be closely linked to specific issues identified and highlighted in the aim of the study.

Prompt 1

Most medical students suffer from coveritis.

This prompt was included on the basis of students' remarks on open-ended items in Questionnaire II, and the finding that only 27% of students indicated in Questionnaire II that playing the MMFWF game, stimulated them to do additional reading on a specific topic.

Prompt 2

Medical microbiology will always be boring and overwhelming, no matter how it is presented.

It was found from Questionnaire I results that 50% of students were enthusiastic about the Infections module. After playing MMFWF (Questionnaire II results), 73% of respondents indicated that they felt more enthusiastic about the subject, and 82% said the game had a positive influence on their perception of medical microbiology.

Prompt 3

The board game will lose its appeal if it is expected of students to play it routinely as part of compulsory group sessions.

In Questionnaire I, 32% of respondents felt that medical microbiology was suitable to learn in small groups, while 53% did not agree and 15% were uncertain. However, after playing MMFWF, 83% of respondents indicated in Questionnaire II that many of the questions in the game resulted in spontaneous group discussions.

Ethical approval to conduct this research was obtained from the Ethics Committee of the Faculty of Health Sciences, UFS. The statistical analysis of data generated by means of the questionnaires was done by the Department of Biostatistics, UFS. Results were summarised as frequencies and percentages for categorical variables.

RESULTS AND DISCUSSION

After completion of the Infections module, but prior to playing the game, 109[3] third-year medical students completed Questionnaire I. Although they all participated in the game, only 100 students completed Questionnaire II. Table 1 lists Questionnaire I items regarded as indicators of the issues investigated, including students' self-reported (i) motivation for learning (two items); (ii) approach to learning (17 items); (iii) application of higher learning skills (20 items); and (iv) opinion on the volume of information before playing the game (one item).

Table 2 lists Questionnaire II items (after playing MMFWF) regarded as indicators of students' (v) experience of the volume of information included in the game (four items); and (vi) retention of knowledge (two items).

Between approximately one quarter and one third of the students either did not value or realise the importance of a deeper understanding of the subject content, which is supported by the results shown in Table 1, items (iii) 2, 10, 11 and 16. For example, in response to the item reading *It was important to me to find the meanings of concepts/terms in medical microbiology that I did not understand* [Table 1, item (iii) 11], 25.7% of students said no. Also, 31.2% did not agree that formulating concepts in medical microbiology was more important than memorisation of the content [Table 1, item (iii) 16]. Results shown for items (iii) 3 and 15 in Table 1 further point toward a lack of understanding, with 17.4% of students indicating that they often encountered facts or definitions without really understanding it, and 15.7% admitting that they did not understand certain concepts in medical microbiology.

[3] See footnote 2, page 151.

Table 1. Questionnaire I items on students' motivation for learning, approach to learning, application of higher learning skills, and opinion on the volume of information in the Infections module.

No.	Questionnaire item	Students' response in percentage (n=109)		
		Yes	Uncertain	No
	(i) Motivation for learning			
1	The only reason why I learned medical microbiology, was because it is a compulsory module that I had to pass.	20.6	12.2	67.3
2	I studied medical microbiology mainly to pass the module.	31.2	5.5	63.3
	(ii) Approach to learning			
1	When I studied for a medical microbiology test, I tried to remember as many facts as possible.	95.4	1.8	2.8
2	When I studied medical microbiology, I wrote down my notes/summaries over and over to help me remember the facts.	35.1	2.8	61.5
3	When I studied for a medical microbiology test, I repeated the facts over and over to myself.	11.9	3.7	84.4
4	When I prepared for a medical microbiology test/exam, I said the words over and over to myself to help me remember.	73.2	1.8	25.0
5	I worked hard in medical microbiology to obtain good marks, although I did not enjoy the classes.	47.2	25.9	26.8
6	I learned medical microbiology by 'teaching' imaginary or fellow students.	23.2	2.8	74.1
7	I explained what I learned in medical microbiology to my friends, parents and other persons.	45.0	7.3	47.7
8	I tried to keep my medical microbiology up to date by studying the new work thoroughly every week.	21.1	5.5	73.4
9	I learned all definitions and medical microbiology facts/detail by heart.	72.5	4.6	22.9
10	I tried to find patterns by means of which I could memorise the work in medical microbiology.	77.1	5.5	17.4
11	I obtained good marks in medical microbiology because I was trained since childhood to achieve only the very best I could.	41.3	11.0	47.7
12	Learning medical microbiology by means of 'teaching' fellow students in a study group (or imaginary students) helped me to master the subject contents.	18.4	9.2	72.5
13	I memorise a lot of detail and facts when I study for a test/exam.	80.7	2.8	16.5
14	I prefer to know all the detail of the information I am busy with, regardless of the subject.	70.6	7.3	22.0
15	I prefer to write a test if I have to prove how much I know about a topic/subject.	68.8	5.5	25.7
16	I like detailed notes when I have to prepare for tests and exams.	68.8	7.3	23.8
17	When I have to start learning new study material, I am afraid that I will not be able to manage all the facts.	36.7	4.6	58.7

Table 1 ***(continued)***

No.	Questionnaire item	Students' response in percentage (n=109)		
		Yes	Uncertain	No
	(iii) Higher learning skills			
1	It was difficult to determine for myself what the most important aspects of medical microbiology were that I had to know.	35.8	8.3	56.0
2	I always tried to understand what the medical microbiology lecturer(s) said even if it did not really make sense.	63.0	10.2	26.9
3	I have often read facts/definitions in medical microbiology without really understanding it.	17.4	7.3	75.2
4	When I studied a specific topic in medical microbiology, I tried to fit all the aspects together.	76.8	4.6	18.5
5	When I read medical microbiology study material, I tried to relate new information to work that I already knew.	73.2	7.4	19.4
6	The medical microbiology lecturers used terminology that I did not understand and that confused me.	9.2	5.5	85.3
7	I can think of examples where I could apply the knowledge I obtained on medical microbiology.	82.4	3.7	13.9
8	I knew what to do when I had to find solutions or analyse results in medical microbiology.	48.6	24.8	26.6
9	I tried to find a link/relationship between the different sections of medical microbiology.	78.0	4.6	17.4
10	It was more important to me to understand certain concepts in medical microbiology than just knowing the content.	70.6	5.5	23.8
11	It was important to me to find the meanings of concepts/terms in medical microbiology that I did not understand.	70.6	3.7	25.7
12	I try to apply in my daily living what I have learnt in medical microbiology.	46.8	5.5	47.7
13	I formed a picture as a whole of the work I had to learn before I started studying for a medical microbiology test/exam.	47.7	5.5	46.8
14	When I did not understand the work in medical microbiology, I tried to approach it from a different perspective until it made sense.	63.0	6.5	30.6
15	I did not understand certain concepts in medical microbiology.	15.7	4.6	79.6
16	In medical microbiology, formulating concepts is more important than memorising.	56.0	12.8	31.2
17	I understood how definitions in medical microbiology should be applied to understand certain processes/concepts.	64.2	13.8	22.0
18	I discussed concepts, terms and aspects of medical microbiology that I did not understand with fellow students.	57.4	0.9	41.7
19	I became trapped/entangled in less important detail when I studied medical microbiology and could not see the bigger picture.	25.7	9.2	65.1
20	If I had to make a diagnosis of an infectious disease and decide on its treatment TODAY, I would feel confident to do so.	19.3	22.0	58.7
	(iv) Opinion on the volume of information in the Infections module			
1	Medical microbiology required a lot more discipline and effort than any of the other second-year modules.	75.2	7.3	17.4

Table 2. Questionnaire II items on students' experience of the volume of information included in the MMFWF board game and retention of knowledge acquired in the Infections module.

No.	Questionnaire item	Students' response in percentage (n=100)		
		Yes	Uncertain	No
	(v) Opinion on the volume of information in MMFWF			
1	I obtained quite a lot of new knowledge by playing MMFWF.	84.0	0	16.0
2	The exposure to MMFWF made me realise that I still have a lot to learn about medical microbiology.	99.0	1.0	0
3	MMFWF made me realise that medical microbiology is an extremely vast field of study.	96.0	0	4.0
4	I think when I am qualified one day and practice as a doctor, I will reach a point where I know enough about medical microbiology and infectious diseases.	45.0	7.0	48.0
	(vi) Retention of knowledge			
1	MMFWF made me realise how little I remember of what I have learnt in the Infections module.	82.8	0	17.2
2	I think I remember a lot of what I have learnt in the Infections module by playing MMFWF.	58.0	8.0	34.0

The results of the two questionnaire surveys will be discussed further by focusing on (i) motivation for learning; (ii) method of memorisation; (iii) cramming versus continuous study; (iv) mastery of higher learning skills; (v) confidence about knowledge retention; (vi) volume of information; (vii) retention of knowledge; (viii) 'covering' of the content versus genuine personal interest; (ix) importance of basic science knowledge; and (x) interest in extended study in medical microbiology.

(i) Motivation for learning

The results in Table 1 show that in a relatively small percentage of students, motivation to learn the subject content [items (i) 1 and 2; 20.6% and 31.2%, respectively] was primarily focused on passing the module. Experiencing the subject as interesting and stimulating might thus have played a role in the remainder of students' motivation for learning. This finding corresponds with the results obtained on a questionnaire item not shown in Table 1, to which 64.2% of students confirmed that they enjoyed medical microbiology as a subject.

A substantial proportion of students [items (ii) 4, 9, 10 and 13] indicated that they applied rote learning when studying medical microbiology. Almost one third of the students (31.2%)

regarded memorisation as more important than formulating concepts in medical microbiology [Table 1, item (iii) 16]. Motivation for learning that is exclusively focused on achieving a goal – that is, to pass the module – combined with a fear of failure (McManus, 2001; Seifert, 2004) to manage the subject content, was reported by 36.7% [item (ii) 17] of students. In a study investigating the relationship between second-year medical students' assessment results and their approaches to learning, Reid et al. (2007) reported that students' marks correlated positively with deep and strategic learning, while a negative correlation was found between marks and surface learning. They argue that unless students realise that the desired approach to learning is rewarded in terms of assessment outcomes, they will not be motivated to adopt such an approach. Paul Ramsden (2010:s.p.) states that *far too often we fail students by producing graduates who are good at learning facts… They wander feebly through their assessments by faithfully repeating what they've heard and read. This is a very poor kind of student experience*.

(ii) Method of memorisation

Item (ii) 4 in Table 1 represents what is referred to as *recitation* (Pauk, 2000) by experts who advocate methods and techniques to improve memory and the ability to memorise detail. In this study, 73.2% of students indicated that they learned the subject content by repeating the words over and over to help them remember [item (ii) 4]. According to Pauk (2000), information is transferred from the short-term (primary) to the long-term (secondary) memory by means of verbal repetition. He warns, however, that students should not *recite the material word for word; rather… reciting should be in words and manner* (sic) *that you would ordinarily use [as] if you were explaining the material to your roommate* (Pauk, 2000:s.p.). Students were encouraged by the module leader to apply peer teaching – the well-known *to teach is to learn twice* principle (Whitman, 1988:s.p.) – when studying medical microbiology by explaining the material to real or imaginary fellow students. Peer teaching has been found to promote understanding of the subject material (Whitman, 1988). According to Fransson (1976:44) in his article on group-centred instruction, a *mighty teaching resource… resides in the students themselves and their interaction*, and that *silent passive students [are] an enormous waste of teaching potential*. Regardless of the benefits of peer teaching pointed out

to the students by the module leader, less than 25% [Table 1, items (ii) 6 and 12] of participants indicated that they learned medical microbiology content by means of this method.

(iii) Cramming versus continuous study

Medical students have been described as exceptionally intelligent, and are selected from among the best of students. Therefore, doing well academically during their studies is duly anticipated (Achike & Ogle, 2000) and possibly expected by themselves, their relatives and peers. Due to assessment systems employed in schools from as early as primary level education, many students – perhaps the majority – start their university studies with motives predominantly focused on marks to determine success or failure (Fransson, 1976). McKeachie (cited by Fransson, 1976:59) argued that *the lack of curiosity and internalised motivation is often the result of years of teaching which has so emphasised extrinsic incentives that the student has had few opportunities for finding intrinsic satisfaction*. The assessment system still employed by most universities and medical schools, namely to be promoted on the basis of marks achieved, could arguably contribute to the perpetuation of a strategic approach to learning. From the questionnaire results, it was evident that more than 40% of students possibly focused on a strategic approach to learning in the Infections module [Table 1, items (ii) 5 and 11]. However, despite these results, it could not be assumed unequivocally that students who applied strategic learning in this module, did not use study techniques promoting insight into and integration of the subject content. Although it has been asserted that strategic learning could be associated with a *patchy and variable level of understanding* (McManus, 2001:383), it was beyond the scope of this study to investigate and assess students' level of understanding of medical microbiology and infectious diseases. From anecdotal comments made by specialist colleagues involved in medical students' clinical training, however, it could be deduced that they experienced senior students as lacking basic knowledge of microbiology and infections. Alternatively, this observation could be attributed to reduced retention of knowledge and not necessarily a lack of deep understanding of the subject.

At the beginning of each new semester of the Infections module, the first author (MCS), acting as module leader at the time of the study, fervently advised students to study every session's work thoroughly before being exposed to new information dealt with the subsequent week. From personal experience as a lecturer in the field, she attempted to convince them that starting to prepare for a test in the Infections module less that a week in advance, would surely let them end up in difficulty with the volume of the work. In the past, students were asked during informal conversations to single out one reason for performing poorly in a test. They most frequently indicated that they had misjudged the volume of work and had not started to prepare for the test well ahead of time. However, with regard to regular, continuous learning of the module content, only 21.1% of students indicated in Questionnaire I that they had studied the work dealt with in each session of the Infections module on a weekly basis [Table 1, item (ii) 8]. It could thus be concluded that 73.4% of the class indirectly admitted to cramming shortly before writing a semester test. When study material is not dealt with and mastered on a continuous basis, students are left with no other choice than to study a large amount of work in an insufficiently short period of time. Not only will circumstances such as these result in surface learning and trying to memorise as much as possible, it could lead to stress and anxiety that may further handicap the learning process (Mattick & Knight, 2007).

(iv) Mastery of higher learning skills

Results on questionnaire items representative of higher learning skills [Table 1, items (iii) 2, 4, 5, 7, 9–11, 14 and 17] were somewhat more encouraging, with between 63.0% and 82.4% of participants reporting such skills with regard to learning medical microbiology. The majority of students indicated that they had made an attempt to integrate newly obtained information in the Infections module into existing knowledge and apply it to other fields of medicine.

(v) Confidence about knowledge retention

Although they successfully completed the Infections module, only 19.3% of students felt that they would be confident to manage an infectious disease case at that point in time [item (iii) 20]. It could be reasoned that the remainder of the class, of whom 58.7% would not feel

confident and 22.0% were uncertain, were of the opinion that they required more exposure to medical microbiology and infectious diseases in the system-specific modules. These modules, focusing on the urinary, genital, cardiovascular, respiratory, endocrine, gastrointestinal and central nervous systems, all included at least one session exclusively dedicated to infections associated with each specific system. It could further be argued that many students would possibly not feel confident to diagnose and propose treatment for an infection based primarily on theoretical knowledge (that is, shortly after completion of the Infections module), and would prefer to acquire more clinically-based experience of infectious diseases before gaining sufficient confidence to manage such patients.

Based on their feedback, a lack of higher learning skills was demonstrated by a relatively small percentage of students, with 17.4% indicating that they learned medical microbiology facts and definitions without really understanding it [Table 1, item (iii) 3]. Between 25.7% and 35.8% of students reported difficulty when they attempted to determine the most important aspects of the module for themselves (items (iii) 1, 19). This finding is supported by the argument made by Mattick and Knight (2007) and Guilbert (2001), that many undergraduate medical students do not have the ability to establish which components of a subject's content is more important and what depth of knowledge should be achieved.

Kriel, Hewson, Zietsman and Coles (1988) propose that one of the reasons for newly graduated doctors not being fully proficient at solving clinical problems, can be attributed to the way in which information becomes programmed and fixed into memory during their time of study. They argue that coming to a diagnosis in medicine does not consist exclusively of either factual textbook knowledge or the cognitive processes of problem solving. Information acquired should be applied and processed within the context of authentic situations, and doctors recognise patterns or prototypes, or characteristic clinical attributes of a specific disease entity, through which the relevant information stored in memory is accessed. This pattern recognition requires a deep, rich and highly structured knowledge base, with information being distinctly interrelated in order to promote recall (Kriel et al., 1988).

(vi) Volume of information

Students' opinion on the volume of information encountered in the Infections module was not directly determined by Questionnaire I. However, item (iv) 1 in Table 1 could be perceived as suggestive of students' experience of the module, possibly with regard to both volume and difficulty, as 75.2% of them indicated that medical microbiology required a lot more discipline and effort than any other module taken in the second year of study. After playing the MMFWF board game, the majority of students indicated that the exposure to the game made them realise that even after successful completion of the Infections module, their knowledge of medical microbiology was rather limited [Table 2, item (v) 2]. Playing the game made them experience the vast extent of medical microbiology as a field of study [item (v) 3], and they obtained new knowledge during the play process [item (v) 1]. These findings show that, despite complaining about the volume of work covered in the Infections module, students realised that the information dealt with in the module was not completely representative of medical microbiology as both a basic science and a clinical entity. As a field with applications and relevance in multiple disciplines of medicine, the core of medical microbiology as presented in the Infections module, where core knowledge refers to the *essential or key aspects of a subject or discipline* (Harden 2001:41), is considered by the students to be quite extensive. It is therefore not surprising that students, after having been exposed to the so-called core of medical microbiology in the Infections module, and then confronted with even more new information in the MMFWF board game, realised that medical microbiology as a field of study is not nearly limited to the knowledge obtain while doing the Infections module.

It was noted with apprehension that 45% of students believed that they would at some stage in future, when they were qualified and practicing as doctors, reach a point where they would not require new knowledge on medical microbiology and infectious diseases [Table 2, item (v) 4]. By implication, this finding suggests that close to half of this group of students were not consciously inclined to life-long learning in medical microbiology. When considering Harden's (2001:39) statement that *[i]t has been estimated that information in the biosciences is doubling every 20 months [and] [i]f this is true, by the end of a doctor's career there will be a million times more information available than when he or she qualified*, it was a matter of

concern that these students did not recognise the importance of continuously staying up-to-date with new developments in this field of medicine.

(vii) Retention of knowledge

With regard to students' retention of knowledge in the period between successfully completing the Infections module and playing MMFWF, which was less than three months, 82.8% indicated that playing the game made them realise how little they remembered of what they had learnt in the module [Table 2, item (vi) 1]. It could be argued that these students were in effect admitting their lack of retention of the knowledge acquired in this module over such a short period of time. A conflicting finding, however, was that during the play process, 58.0% of students experienced that they remembered of lot of what they had learnt in the Infections module. On the one hand, it is remarkable that such a large proportion of students realised how little they could remember from the module; on the other hand, it could be regarded as encouraging that more than half of the participants indicated that they remembered a good deal of the module while playing the game. Any explanation for this inconsistency in findings would be speculative.

Based on Bluma Zeigarnik's observations and the definition of the Zeigarnik effect, it is proposed that after completion of a specific module at the end of an academic semester, the content of that module – or at least unconsciously selected parts of it – is/are forgotten to some extent. We further argue that having written the final examination in a module and obtaining the minimum mark required to pass that module, may have the same psychological effect as any other completed task that can be ticked off a list. Consequently, the details of the task – in this case the factual content of the module that has been completed successfully – may even be forgotten.

The term *disuse atrophy* was coined in 1932 by Cole (cited by Custers, 2010:110) to describe the fate of basic science knowledge once medical students enter the clinical environment. Custers (2010:110) also quote Miller and his co-workers who stated in their book *Teaching and Learning in Medical School*, published in 1961, that *for students to retain a mere ten*

percent of the anatomy and physiology offered in the traditional first-year course, was not an uncommon occurrence. With his description of medical students' attitude towards the basic sciences, Blizard (cited by Custers, 2010:110) confirms the authors' opinion that students' approach to medical microbiology is characterised by a primary focus on *passing the examinations, forgetting the whole business, and then getting on with the job of becoming a doctor*.

(viii) 'Covering' of content versus genuine personal interest

From the feedback obtained by means of the focus group interviews, it became clear that although students experienced the volume of work covered in the Infections module as *too much* and *overwhelming*, they realised the importance of medical microbiology in the clinical practice of medicine. Similar to the questionnaire item investigating students' enjoyment of medical microbiology [see paragraph (i)], they confirmed in the focus groups interviews that they found the information interesting and stimulating. They did indicate, however, that when preparing for a test or examination, they had difficulty to determine by themselves the importance of certain sections of the work, and focused mostly on passing assessments.

The definition of coveritis originally proposed by Guilbert (1998) was presented to the participants in the focus group interviews, using the prompt *most medical students suffer from coveritis* to elicit conversation. It was interesting that the interviewees immediately "modified" Guilbert's definition of coveritis and interpreted the concept from their perspective and experience of the Infections module, as covering just enough of the work to ensure that one passes the module. For example, remarks such as *there are so many organisms… I want to know the most important ones… to cover myself*, and *you try to get away with as little as you can*, were made. These opinions are confirmed by the statement made in *Tomorrow's Doctors* (General Medical Council, 1993), namely that students are reluctant to spend time on topics and issues on which they will not be assessed. With regard to the MMFWF game as a potential group work activity, several of the students explicitly stated that they would prefer to encounter questions during the play process that would be included in test and examination papers. One student, for example, said:

> *Let me take this thing back to what we have to cover in the Infections module. Then I know if I were attending the group work sessions with the game I know we ask [sic] the same questions then it just comes back to why I'm there in the first place. Just to get the questions for the exams.*

In addition to the students' comments during the focus group interviews regarding their own interpretation of coveritis, similar reactions were elicited by an open-ended item in Questionnaire II requesting critique and recommendations on the MMFWF board game. Students' feedback on the game's question-and-answer content included remarks such as,

- *Some questions were not covered in the Infections module*;
- *We have not done all the questions/answers in the Infections module*; and
- *The graphic visual images didn't help me because I haven't seen them in the Infections module*.

These comments reflect students' possible lack of intrinsic motivation, and may be an indication that they resorted to learning the subject content from a surface perspective. However, merely being interested in the content of the subject because of its novelty and fascinated by the examples of clinical cases, would not necessarily promote deep learning and thus understanding. Sandoval (1995) cited Krapp, Hidi and Renninger, who distinguished between situational and personal interest, and explained that situational interest occurs among a group of individuals and results from different circumstances in the learning environment. Personal interest, on the other hand, is *idiosyncratic, develops slowly, ... is long-lasting… [and] results in increased attention and positive affect in a learning situation* (Sandoval, 1995:12). The state of interest, as proposed by Ainley (2006:398), *links motivation, affect and further cognitive activity*. Emotions, motive for learning and cognition (knowledge seeking) operate as a synchronised system when a true state of interest is attained (Fredrickson, 2001). It can therefore be argued that a true state of interest in the Infections module would be reflected by a deep approach to learning, driven by a need to understand and integrate the information acquired.

(ix) Importance of basic science knowledge

According to Woods (2007), teachers in the clinical disciplines occasionally question the role of basic science information in everyday clinical reasoning. They assert that most clinicians concentrate on the evaluation and interpretation of the patient's history, and symptoms and signs found on physical examination. However, Woods (2007:1174) strongly argues that

> *… [a] clinician who believes that he does not use his basic science knowledge may simply be expressing a type of meta-cognitive bias… They simply do not recognise (and therefore cannot verbalise) how their knowledge of [the basic sciences] shapes the way they view, organise and interpret clinical information.*

Woods (2007) continues with her argument by asserting that not being aware of the impact of basic science knowledge, does not reduce its explicit importance. Basic science knowledge continues to play a subtle, yet important role in expert reasoning, despite the obvious impact of the clinical sciences and clinicians' lack of retention of basic knowledge.

According to Schmidt's knowledge encapsulation theory (Rikers, Schmidt & Moulaert, 2005), students' knowledge of the basic sciences is progressively integrated with or encapsulated in their clinical knowledge. This process of integration results from purposeful, comprehensive application of the encapsulated knowledge, mainly by means of exposure to patients in real-life situations. By the time medical students reach the level of skilled physicians, their basic science knowledge foundation has become an integrated part of their clinical knowledge, thus permitting so-called shortcuts in the process of clinical reasoning by omitting intermediary factual arguments. Therefore, when making a diagnosis, they observe and process the patient's symptomatology as a collective unit, without having to deliberately apply their basic knowledge to come to a conclusion (Rikers et al., 2005). With regard to academic success and clinical competence, Rhoads, Gallemore, Gianturco and Osterhout (1974) made the interesting observation that only 50% of students who excelled in basic science courses, also did well in

clinical disciplines, as opposed to 70% of those who excelled in clinical courses but not in basic sciences.

Biological sciences are multi-faceted and intellectually demanding, with the knowledge base not only increasing, but also changing at a rapid pace (Watters & Watters, 2007). From Woods' (2007) arguments, however, supported by Schmidt's knowledge encapsulation theory (Rikers et al., 2005), it is encouraging that evidence is available to show that basic science knowledge does not simply disappear completely from a doctor's memory and frame of reference. Furthermore, despite the decrease in students' factual basic science knowledge, it has been found to be accompanied by a positive development in their biomedical reasoning skills as they progress and mature during their clinical years of training (Collard, Gelaes, Vanbelle, Bredart, Defraigne, Boniver & Bourguignon, 2009). Conceptual management of knowledge is of prime significance for proficiency in medical practice (Mateen & D'Eon, 2008), and therefore students must learn from their clinical teachers as mentors how to incorporate their existing medical microbiology knowledge into the clinical reasoning process.

(x) Interest in extended study in medical microbiology

It is regrettable that based on their experience of the subject during pre-clinical training – especially regarding the volume and difficulty of the work – very few students are interested in pursuing medical microbiology on a postgraduate level to become specialist pathologists in the field. Greenbury (1971:551) stated 40 years ago that *the demand for consultants in all specialties… [was] likely to exceed the supply*, with the greatest deficit predicted for medical microbiology and chemical pathology. Jombo (2006) reports that although 76.5% of students in his study found pathology interesting, only 2.4% of them indicated that they would consider a career in medical microbiology. A similar observation was made in the study reported here, with Questionnaire I results showing that 5.6% of students would like to specialise in medical microbiology, despite the fact that almost two thirds of them reported that they enjoyed the module. With regard to the current shortage in medical microbiology pathologists not only in South Africa (Kaschula, 2006), but globally (Chetty, 2005), serious attention should be given

to the reasons why students already decide at an undergraduate level not to pursue this field as a professional career.

By introducing innovative methods as part of the learning process, a keen interest in microbiology and infectious diseases among medical students might be developed. Motivated, positive and enthusiastic teachers bring forth students that are equally excited about the subject being presented (Harden & Crosby, 2000; Montalvo, Mansfield & Miller, 2007; Radel, Sarrazin, Legrain & Wild, 2010). Combining an enthusiastic mode of teaching with a stimulating and challenging learning tool, such as playing a highly interactive game, may contribute to students' positive experience of the subject in such a way that deep learning, understanding and optimal integration of the content will be promoted. As Lujan and DiCarlo (2006:21) pertinently recommend:

> *... we should unpack the curriculum and help students become active, independent learners and problem solvers. Collaborative learning activities, interactive models, educational games, and establishing a culture of inquiry/ scholarship are critical for achieving these goals.*

CONCLUDING REMARKS

What then, based on the research findings and review of the literature, is the prognosis of students suffering from this comorbidity of conditions impeding the learning process in medical microbiology? After careful evaluation of the results presented here, the authors agree that some students run the risk of not developing a deep understanding and integration of the knowledge acquired in the Infections module. Although most students find this field of study interesting and enjoyable, and realise its importance from a clinical point of view, they are challenged by the volume and complexity of its factual content. Despite resorting to rote learning in an attempt to be successful in tests and examinations, students will eventually be able to adequately apply their knowledge of basic science in the clinical environment, without even being consciously aware of the autonomous process of recall from memory.

An innovative approach to presenting the factual information of the subject has the potential to change students' attitudes towards and perceptions of medical microbiology and infectious disease. It does not have to replace lectures and formal teaching sessions, but students may benefit from playing an interactive game as part of group activities to reinforce information obtained during lectures. Students should be allowed and encouraged to talk about what they are learning, become involved in discussions, and exchange ideas and opinions about their newly acquired knowledge (DiCarlo, 2009). The MMFWF board game offers all these possibilities, and its inclusion as a learning opportunity in the Infections module of the undergraduate medical curriculum is recommended.

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ARTICLE V

A CASE STUDY ON THE USE OF AN ONLINE MULTIPLE-CHOICE GAME TO IMPROVE STUDENTS' ACADEMIC PERFORMANCE IN THE INFECTIONS MODULE OF AN UNDERGRADUATE MEDICAL PROGRAMME

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ABSTRACT

Many misconceptions exist around the word 'play' as it is regarded as a childhood activity of debatable instructional value. Nevertheless, educational games are increasingly used in medical training programmes to enhance the process of mastering subject content. Medical microbiology is experienced by many students as difficult because of new terminology and the extensive volume of this field of study. Consequently, many students believe that medical microbiology could be a major contributor to failing an academic year. This paper describes a single case of the use of an online multiple-choice game to improve students' performance in the Infections module of their medical training programme. The results show that even in institutions of higher learning, an informal approach to learning may be beneficial to students.

INTRODUCTION

Although play is a powerful mediator for learning throughout a person's life, the word *play* can invoke many misconceptions. Traditionally, play is viewed, for example, as applying only to young children and is seen as something to be abandoned when adulthood is reached. The activity of play is also often regarded as irrelevant or inconsequential to either formal or informal learning (Rieber, 1996).

Despite these views, educational games have been defined as instructional activities where learners are provided with motivation, entertainment, competition and reinforcement, which should promote enjoyment of a learning experience where the transmission of knowledge takes place (Herselman, 2000). Constructive games played by adults involve interactive learning environments where the structure or nature of the game and motivation to learn and participate are optimised, without subverting personal discovery, exploration, and ownership of knowledge; in other words, learning environments that are encouraging people to play. Work has the potential to be considered as play when the job that has to be performed, becomes so satisfying and rewarding that getting paid/rewarded to do it, is of secondary importance (Rieber, 1996).

For students to excel in a particular field of study, they have to display a positive attitude, enthusiasm and interest, not only towards the content of what is being taught, but also towards the learning process and the prospect of becoming and remaining lifelong learners in that specific field. Higher education succeeds or fails in terms of motivation, not in terms of the amount or the content of information transferred to students on a cognitive level. According to Walsh (1999), education succeeds (i) if it instils in students a willingness to pursue knowledge for its own sake, and (ii) if the desired result of higher education, which is to develop intrinsically motivated learners, is achieved.

In a discussion on the connection between the elements of play and education in Plato's dramatic dialogue *Republic*, Krentz (1999:s.p.) pointed out that etymologically the Greek words for education (*paideia/*παιδεια), play/game/pastime/sport (*paidia/*παιδια) and children (*paides/*παιδεσ), have the same root. These three terms are also often encountered in the same context. Against this background, he also stated that the central aim of

pedagogy (*paidagogia/*παιδαγογια) was to encourage learning as a form of play (*paidia/* παιδια) and emphasised it as the most persuasive and effective approach to learning (Krentz, 1999).

If one takes into account that Plato lived round about 428–347 BC (Kraut, 2009) and that Greek is one of the oldest languages known to humankind, it is evident that the importance of play as part of the learning process and educational development had been recognised since ancient times. Dewey suggested in 1933 (cited by Rathunde and Csikszentmihalyi, 1993) that the ideal mental condition for learning to take place to an optimal extent requires being playful and serious at the same time.

Medical training is not regarded as a field of study leaving room for play. This point of view is not necessarily attributed to the complexity of concepts, but rather the extensive volume of work that has to be mastered in a relatively short period of time, which usually involves five to six years of fulltime lectures, discussions, assignments, clinical training and assessment. Therefore, it would not be an unexpected response in an audience of medical students, doctors and educators, to see eyebrows raised and heads nodding in agreement at hearing the following words, communicated by a distinguished speaker.

> *If the prospective medical student could intelligently appreciate the volume of intricate facts and principles he will be called upon to master, he might well be appalled and deterred from proceeding further… It embraces in addition all the multiform abnormalities of the human organism as the arena where the student's knowledge and skills are to be exploited. To see the simplest collection of books representing the medical curriculum, to sense the endlessly accumulating body of detailed facts they represent, and to realize the vast laboratories from which they have and ever continue to arise, is to become aware of an herculean intellectual task set for the medical student. One marvels that any individual ever becomes the master of even the basic core of information which these books and the libraries they represent, contain* (Haggerty, 1929:42).

This argument was expressed more than 80 years ago in 1928, when Professor Melvin E. Haggerty, then Dean of the College of Education, University of Minnesota, Minneapolis, addressed the Association of American Teachers of the Diseases of Children on 'The Improvement of Medical Instruction' (Haggerty, 1929). Not surprisingly, these words are still remarkably applicable. Dent (2001) stated that medical knowledge is increasing exponentially, and with the continuously escalating development in information technology, the demands on students in any field of study are burgeoning on a daily basis.

Apart from the enormous amount of work that medical students in particular have to manage in their five or six years of training, formal assessment is associated with its own demands and emotional pressure. Succeeding in assessments that test knowledge acquired by means of rote learning is often regarded as evidence of the fact that the material had been mastered to a satisfactory degree (Thatcher, 1990). According to Bandaranayake (2001), it is a well-known fact that assessment is the strongest motivating factor for students to learn. Although Walsh (1999) made the thought-provoking statement that education has failed when students learn with the singular purpose of passing a test or obtaining a degree, the reality has to be faced that students' motivation for learning is deeply embedded in this marks- or grades-driven system of academic promotion.

Internationally, in the vast majority of schools, universities and other institutions of higher education, tests need to be passed in order to be allowed to sit an examination, which, in turn, has to be passed in order to proceed to the next academic year. Only after a minimum required number of years had been completed successfully, most commonly measured by marks obtained, a qualification is granted and the individual is permitted to enter the specific profession for which he or she has prepared. This unyielding approach presenting knowledge in exchange for marks to prove success, resulted in the process of learning still being focused on one explicit motivating factor for many students, and that is to pass tests and examinations. The question could be asked whether such a mode of assessment will ultimately result in the development of lifelong learning skills.

Medical training, from its onset and progressing into practice, has been shown by several studies to be a time of significant emotional and psychological distress (Clark & Zeldow, 1988; Dahlin, Joneborg & Runeson, 2005; Dyrbye, Thomas & Shanafelt, 2006; Guthrie, Black, Bagalkote, Shaw, Campbell & Creed, 1998; Henning, Ey & Shaw, 1998; Lloyd &

Gartrell, 1984; Stewart, Lam, Betson, Wong, & Wong, 1999; Toews, Lockyer, Dobson & Brownell, 1993). Assessment performance and pressure, workload and financial responsibilities were identified as some of the most stressful aspects of medical education (Wolf, Faucett, Randall & Balson, 1988; Sansgiry, Bhosle & Sail, 2006), while academic success, second to recreation and social interaction, was rated by graduating students as the most uplifting and satisfying experience (Wolf et al., 1988). Although a certain degree of stress is inevitably part of medical training and the practice of medicine (Dyrbye et al., 2006), not all students are motivated by stress (Linn & Zeppa, 1984), and the lack of coping skills may actually contribute to impairment in academic performance (Moffat, McConnachie, Ross & Morrison, 2004; Mosley, Perrin, Neral, Dubbert, Grothues & Pinto, 1994; Womble, 2003).

In addition to everyday stress and challenges associated with medical studies, students may experience further anxiety when a particular subject is regarded as difficult, voluminous, and its content delivered in the form of unexciting, mediocre lectures. In the School of Medicine, University of the Free State (UFS), medical microbiology had been described by students as interesting, informative, and an important part of their curriculum; nevertheless, the majority of students regarded it as the single most probable cause of failing a year of their training [Beylefeld, 1996 (unpublished data); Bezuidenhout & Nel, 2002 (unpublished data); Bezuidenhout & Van der Westhuizen, 2003 (unpublished data)]. In addition to the emotional impact of poor academic performance (Lloyd & Gartrell, 1984; Richardson, Bergen, Martin, Roeger & Allison, 2005; Reese, 1968) and repeating a year of study, students who fail have to face serious financial implications such as potentially losing bursaries and/or study loans.

BACKGROUND

At the time of the study, the Infections module was part of the undergraduate medical students' pre-clinical training towards an MBChB degree (Baccalaureate in Medicine and Baccalaureate in Surgery), in semester four of the curriculum, that is, the second semester (July–November) of the second academic year. The module was presented for the first time in 2001 in the newly-structured medical curriculum. The Infections module consisted of fourteen three-hour sessions presented separately in Afrikaans and English, the official languages of instruction at the UFS. Apart from Clinical Skills and a special research

module, which were presented over a two-year period (second and third academic years), semester four contained four other modules in addition to the Infections module, namely Urinary System, Immunology and Haematology, Cardiovascular System, and Mechanisms of Disease.

At the time of the study, according to UFS regulations and requirements (University of the Free State, 2004:27), a module mark of 40% was mandatory for a student to be allowed to write the final examination at the end of the semester. A final mark of 50% was required to pass a module, which was determined by calculating the mean of the module mark and the mark received for the examination paper. When a student failed to qualify for an examination – when a module mark of at least 40% was not obtained and the module was thus failed based on test results – the particular academic year had to be repeated in full (that is, all modules, including those that were completed successfully).

Entering the final examination with a module mark below 50% posed a substantial risk of failing the module, should the student's performance in the examination be compromised in some way, for example, due to unforeseen personal circumstances obstructing the learning process. Therefore, students who obtained module marks ranging between 40% and 49% were regarded as critically at risk ('in serious trouble'), while students with module marks between 50% and 54% were considered to be at risk of not passing the module ('not safe'), although to a lesser extent than those below 50%. Even though no formal investigation had been conducted into faculty members' convictions and opinions on this matter, most academic staff locally involved in student training would agree to this point of view, which became evident from informal discussions occurring spontaneously at several Examination Committee and other meetings.

Two formal semester tests (carrying a weight of 40% each) and continuous assessment (carrying a weight of 20%) consisting of six ten- to fifteen-point class tests written on designated dates throughout the course of the semester were taken into account in calculating the module mark in the Infections module.

In August 2004, the second-year medical students wrote their first semester test (Test I) on sessions 1–6 of the Infections module. Although 15.1% (22/146) passed with distinction

(that is, ≥ 75%), 14.4% (21/146) of the group failed the test (< 40%)[1]. A substantial number (25.2% [26/103]) of the students who obtained a regular pass for Test I (between 40% and 74%) were evaluated as 'in serious trouble', while 19.4% (20/103) were regarded as 'not safe'. Thus, based on marks obtained for Test I, 67/146 (45.9%) of the students were either failing, 'in serious trouble' or 'not safe'. When taking into account that the class average dropped by up to 6% from Test I to Test II over the preceding three years (Struwig, Beylefeld & Hugo, 2005), close to 50% of the second-year medical students were at risk of not obtaining the required module mark to write the Infections examination in November of that year. Such an outcome would result in half the class either repeating their second academic year, or dropping out of medical school completely.

Investigating specific reasons for students' poor performance in Test I of Infections falls outside the parameters of this study. From the authors' experience, however, the predominant reasons usually given by students for failing a test or obtaining an unexpectedly low mark, include (i) underestimating the amount of work that has to be mastered; (ii) underestimating the complexity of the work; and (iii) a lack of continuous study in the weeks preceding the test. From the researcher's point of view, Test I of 2004 did not differ from previous years' tests regarding content and level of difficulty.

The researcher, who was the module leader at that time, developed a medical microbiology board game (Med Micro Fun With Facts; MMFWF) as a supplementary learning instrument for students in the Infections module (Beylefeld & Struwig, 2007; Struwig et al., 2005). The game was also converted into an online web-based application in multiple-choice question (MCQ) format. In the online/electronic version of the game (e-MMFWF), the database of 700 questions was categorised into sessions, corresponding with the content of each session of the module (Struwig et al., 2005). The online game was designed and programmed by a colleague in the Faculty of Health Sciences, to show the number of times different sessions were played, as well as the minimum and maximum scores obtained for each session, for each student who accessed the application.

[1] A mark of less than 50% is normally regarded as failing a test. In this particular context, however, a test mark of less than 40% was considered as failing, due to the fact that a student who obtained an average of 40% for both tests, still qualified to write the final examination. In such circumstances, the student should then obtain at least 60% for the examination paper in order to pass with a final mark of 50%.

AIM OF THE STUDY

An unacceptably disproportionate failure rate at the end of the second semester of 2004 resulting from poor marks obtained in Test I, seemed highly probable. The primary objective of the investigation reported here was to address the poor performance of a class of second-year medical students in the first semester test (Test I) of the Infections module.

A second objective was to compare the results obtained for the Infections module with the outcomes of other modules comprising the second-semester learning programme. This was done to determine whether implementation of the compulsory e-MMFWF learning activity (contributing a weight of 10% towards the module mark), in any way disproportionately skewed the final results obtained in the Infections module to the students' advantage.

A third objective was to determine the students' experience of the e-MMFWF game by means of a questionnaire, and also to obtain their opinion on the possible role of the learning activity in their achievement in Test II of the module.

METHODS

In order to address the students' poor performance in Test I, it was decided to introduce compulsory directed learning[2] in the form of playing e-MMFWF. After Test I results were made known to the students, the necessity and benefit of implementing compulsory directed learning was explained to them by discussing and emphasising the potential negative consequences of these results. In addition, a brief motivational talk was presented to encourage those students who performed poorly in the test. The process of gaining access and using the e-MMFWF website was demonstrated to the class. It was proposed to adapt the calculation of the module mark, with the two semester tests contributing 35% each, continuous assessment 20% and the directed learning activity 10%. No objections to the implementation of compulsory directed learning or the adapted calculation of the module mark were received from the students. The general impression based on their verbal feedback was that they felt encouraged and were looking forward to using the e-MMFWF web application (Struwig et al., 2005).

[2] Directed (or self-directed) learning in this context refers to a learning activity performed in the student's own time (Harden, 2001).

The compulsory directed learning was implemented five weeks before the second semester test (Test II), which covered the work done in sessions 7–12 of the module, allowing ample time to use this learning opportunity. It was suggested that students who obtained a mark of 55% and above for Test I should play each session of the online game at least twice, while students with a test mark below 55% were encouraged to play each session at least three times (Struwig et al., 2005).

Students played the required six sessions (7–12) of the online game unsupervised in their own time in the weeks preceding Test II of the module, which was written by mid-October. In order to provide an opportunity for 'last minute' access of the application, the system remained open until the time the test started. All students' information regarding the number of times each session was played, as well as the maximum scores obtained for each session, were obtained from the e-MMFWF web application while they were busy writing Test II. This information was used to monitor whether the required number of times to play was honoured by each student, and to calculate their marks for directed learning.

Marks obtained for Test II were compared with Test I results. In order to determine whether the exposure to e-MMFWF had any influence on students' achievement, the class average of both Test I and II obtained over four consecutive years (2001–2004) were compared (Struwig et al., 2005).

An analysis of students' marks was performed to determine what the outcome would have been had the compulsory directed learning not been implemented prior to Test II of the Infections module. In the case of students who 'should not have passed with distinction' or 'should have failed' without the additional marks obtained for the compulsory directed learning, the final marks obtained for the Infections module were compared to the marks in other second-year modules. This was done to determine whether playing the online game and the adapted calculation of the module mark created a distortion of students' performance in the Infections module. Furthermore, the academic records of students who would not have obtained a distinction or should have failed the Infections module, were reviewed for three consecutive years (2005–2007) to monitor their academic progress in their third to final year of study.

A five-point Likert scale questionnaire was used to evaluate the e-MMFWF application as a learning tool. Completion of the self-administered questionnaire after Test II results were made known, was voluntary and anonymous. Data generated by means of the questionnaire (Struwig et al., 2005) were analysed by the Department of Biostatistics by means of descriptive statistics.

This investigation formed part of a greater research project in medical education for which ethical approval was granted previously by the Ethics Committee of the Faculty of Health Sciences, UFS (Struwig et al., 2005).

RESULTS

The findings are presented in two separate sections, namely (i) the outcome of the implementation of e-MMFWF as a compulsory learning activity on students' academic achievement in the Infections module; and (ii) students' evaluation of e-MMFWF as a supplementary learning tool.

The impact of e-MMFWF as compulsory directed learning on students' academic performance in the Infections module

The marks obtained by the students in Test II of the Infections module in 2004 were a major improvement on Test I results, with the class average increasing with 22% from 57% for Test I to 79% for Test II. The increase in marks from Test I to Test II ranged between 2% and 47%. Three students' (2.1%) marks for Test II were lower than for Test I, while one student (0.7%) obtained the same mark (44%) for both tests. Only one student (0.7%) failed Test II in comparison to 14.4% (21/146) of the class who failed Test I.

Results of Test I and Test II are shown in Figure 1, illustrating the distribution of students across 10% mark intervals. The number of students who passed Test II with distinction was very similar to the proportion of the class that obtained a regular pass in Test I, namely 68.5% and 70.5%, respectively (Struwig et al., 2005). In Test II, only 2.1% of the class obtained a mark of less than 50%, while 30.8% and 22.6% obtained marks in the 80–89% and 90–100% intervals, respectively (Figure 1).

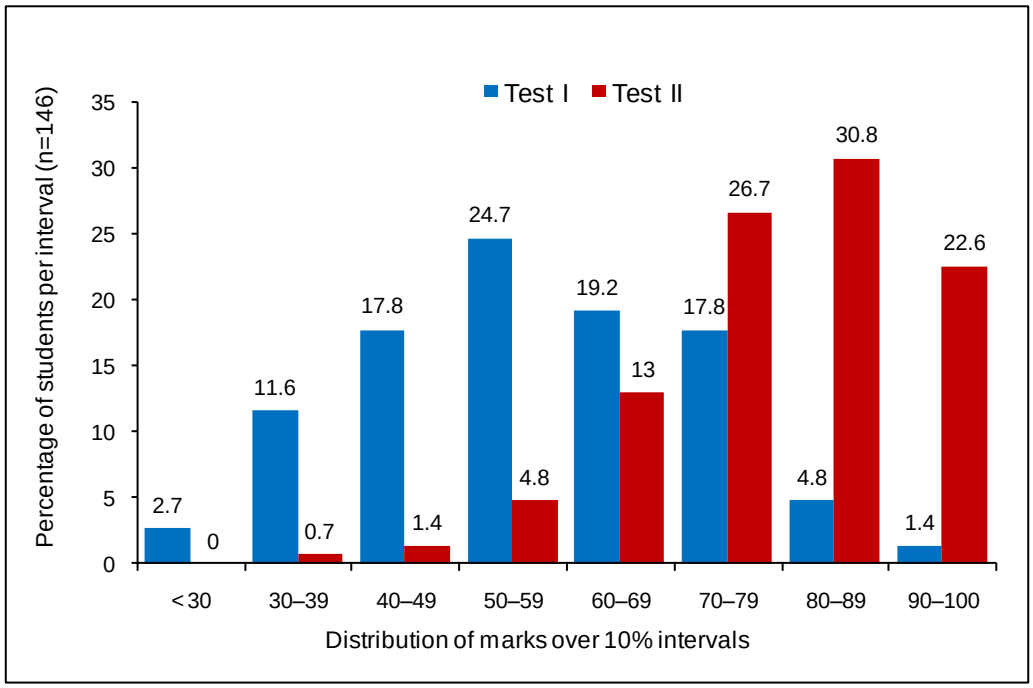

Figure 1. A comparison of the distribution of students over 10% mark intervals for Test I and Test II of the Infections module in 2004.

The results of Test I and II written in the Infections module in 2004 were compared to the test results of the preceding three years (2001–2003). During this period, the class average was either the same for both tests (2001) or decreased in Test II (with 2% in 2002 and 6% in 2003), compared to the 22% increase in the class average from Test I to Test II in 2004 (Struwig et al., 2005).

The increase in students' module marks in 2004 ranged between 8% and 10% from what it would have been without the compulsory directed learning. One student's mark for directed learning increased his module mark by 8%, eight students (5.5%) had an increase of 9%, while the rest of the class (137/146; 93.8%) were able to increase their module marks by 10%.

When the marks obtained for the directed learning activity were excluded from the calculation of the module mark (in other words, if the two semester tests had contributed 40% each and continuous assessment 20%), five students (3.4%) would have failed outright to qualify for the final examination due to module marks below 40%, 15/146 (10.3%) would have entered the examination with an 'at risk' module mark between 40% and 49%, while a further 21 students (14.4%) would have written the examination with an

'unsafe' module mark of 50–54%. It could therefore be deduced that 41 students (28.1%) from the total class potentially would have faced the possibility of repeating the second academic year due to their performance in the Infections module. The five students who would have failed due to not obtaining the required module mark, all eventually did fail the second academic year, but that was due to poor performance in other modules.

Twenty-two (15.1%) students played each session of the game the required number of times, while the majority (122/146; 83.6%) played more frequently. The two students (1.4%) who did not play the e-MMFWF application the required number of times, both obtained less than 60% for Test I. One of these students obtained the same mark (44%) for both tests and failed all the second-year modules with the exception of the module on Immunology and Haematology. The other student obtained 52% for Test I and improved to 80% in Test II. He graduated in December 2007 with an average of 69% and two distinctions.

Only one of the three most prolific players (mean 12.3 times played) completed his studies in the minimum required number of years. Despite being regarded as an 'unsafe' candidate after Test I of the Infections module, this student displayed academic consistency throughout his medical training and obtained an average final-year mark of 61%. The other two prolific players, who played 6.3 and 7.5 times on average, failed the second and the third academic year, respectively.

In order to ascertain whether students' marks obtained in the Infections module were skewed as a result of the compulsory directed learning activity, the final marks of all five the modules presented in semester four were compared. In addition to the Infections module, the modules presented in semester 4 were Urinary System; Immunology and Haematology; Mechanisms of Disease; and Cardiovascular System. The comparison of the mean marks as well as the highest and lowest marks obtained by students in each of these five modules are shown in Figure 2.

Eight students were excluded from these calculations. Their feedback was, however, included in the analysis of the questionnaire results. Four of them were repeating their second academic year and received exemption from examinations in all the modules passed in the previous year, therefore final marks were not available for all their 2004

modules. Three did not obtain the required module mark for all their modules and due to not writing the examination papers, final marks were not available for these modules. One student died in a car accident before she could write her final examinations. She did, however, participate in the evaluation of e-MMFWF.

No failures occurred in Immunology and Haematology, three (2.2%) in Urinary System, five (5.6%) in Mechanisms of Disease, and twelve (8.7%) in Cardiovascular System (results not shown). Seven (5.1%) students still failed the Infections module after their module marks were adapted, which is similar to the failure rate in the other modules of that semester.

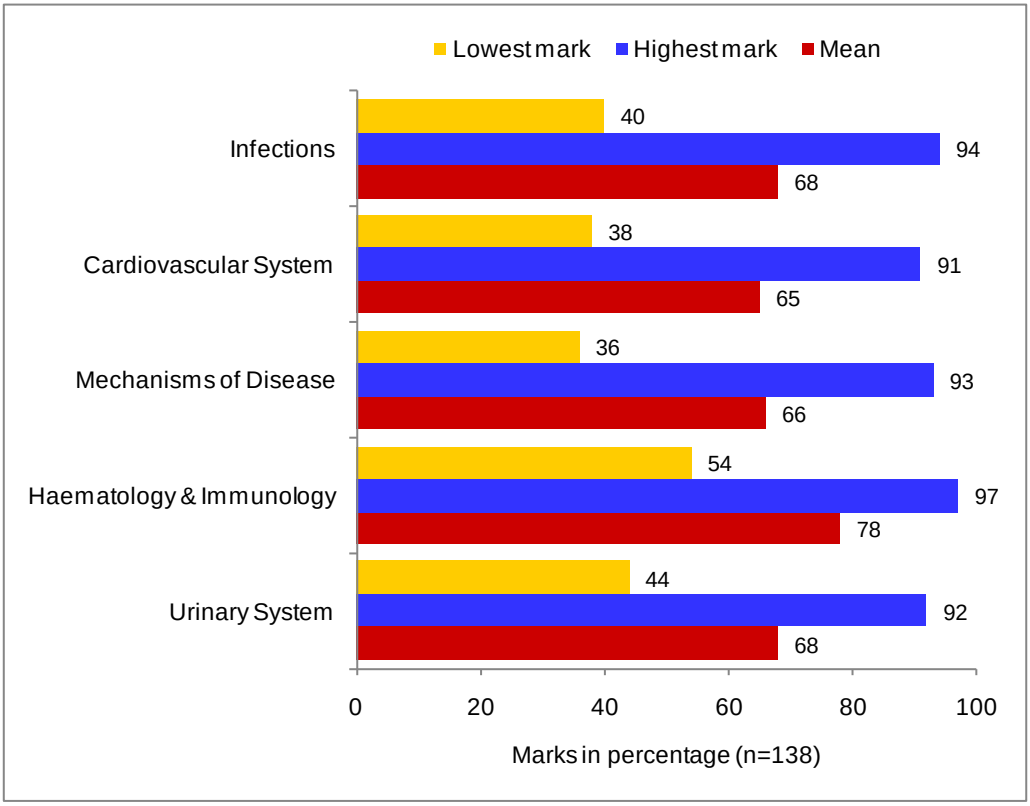

Figure 2. Comparison of the Infections module to the other semester 4 modules with regard to mean, highest and lowest marks obtained by students in each module.

Twenty-two (15.1%) students were identified who would not have passed the Infections module with distinction, had they not improved their module marks by means of the directed learning activity. The final second-year results of these students were evaluated in order to determine whether these distinctions were deserved and justified. This group of students obtained a total of 146 distinctions, including the Infections module, out of a

possible 198, and passed on average 6.6 of their nine second-year modules with distinction. The distribution of distinctions between these students are shown in Table 1. Apart from this group, 22 more students passed the Infections module with distinction; thus in total, 44 distinctions were obtained in the module.

Table 1. Distribution of distinctions obtained in the nine second-year modules by students who 'should not have passed the Infections module with distinction'.

Number of distinctions including Infections	No. of students (n=22)	% of group
Two distinctions	1	4.5
Four distinctions	3	13.6
Five distinctions	3	13.6
Seven distinctions	7	31.8
Eight distinctions	4	18.2
Nine distinctions	4	18.2

Eighteen (81.8%) of these students who 'should not have passed the Infections module with distinction' passed their second academic year with five or more distinctions. The average second-year mark for this group of students, with inclusion of the Infections module, was 78.1%.

The difference between the mark obtained for the Infections module and the mean mark for the other eight second-year modules was calculated for each of these students. This was done to evaluate the mark obtained for the Infections module in comparison to the student's performance in the rest of the modules. The difference between the mark in the Infections module and the mean of the other modules ranged between minus two and six percent. The mean difference was two percent. Five students had no difference between their marks for the Infections module and the other modules' mean mark, while another five students had a lower average (1% to 2% lower) than the mark obtained for Infections. Of those students who had a higher average overall than the mark obtained for Infections (12/22; 54.5% of the group), the difference ranged between two and eight percent.

These students all completed their medical studies successfully in the minimum period of five years and graduated in November 2007. The distribution of distinctions obtained in the final academic year by students who 'should not have passed the Infections module with distinction' is shown in Figure 3. The average mark obtained by this group of students in their final year of study was 69.8%, only 8.3% lower than the average mark obtained at the end of their second year.

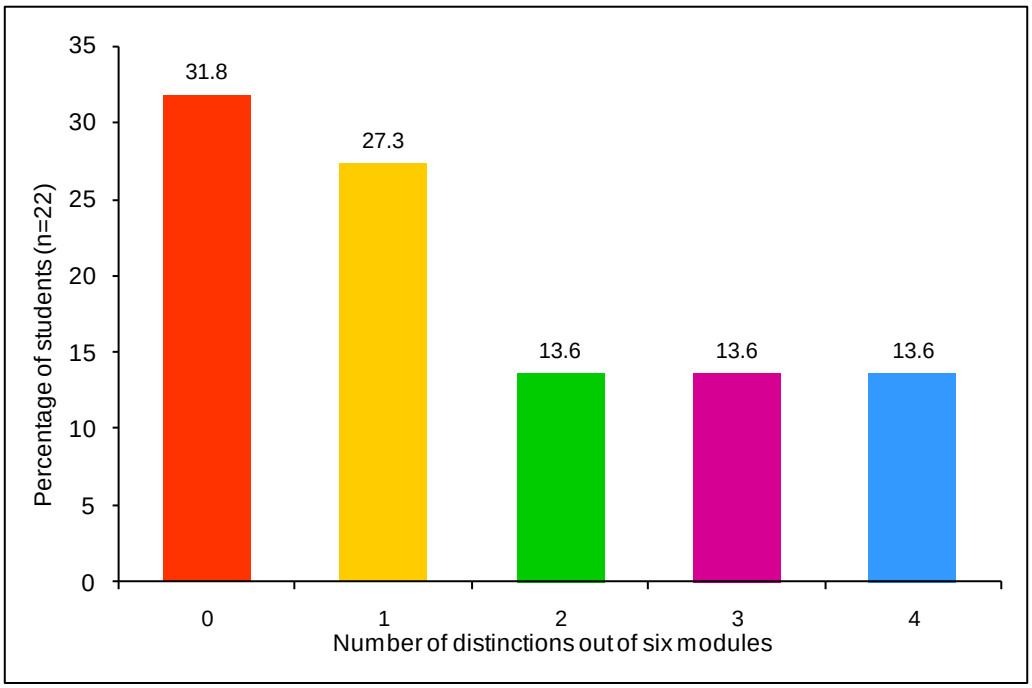

Figure 3. Distribution of distinctions in six final-year modules among students who 'should not have passed the Infections module with distinction'.

Four students, who would have qualified to write the supplementary examination instead of obtaining a straight pass in the Infections module, were identified. Their final marks for Infections would have been between 45% and 49%, had the directed learning mark not been taken into account. In the event of a supplementary examination the stakes are even higher, with the module mark, first examination mark and second (supplementary) examination mark each contributing one third to the final mark.

These students' final second-year results were evaluated and compared to their Infections marks in order to determine whether their straight passes were justified. They all passed the other eight modules with an average ranging between 56% and 61%. Based on their academic progress reports reviewed at the end of their final year, three of these students

had successfully completed their medical studies with an average mark ranging between 58% and 66%. The other student failed the third year and no further academic progress reports were investigated.

Two students who qualified for the supplementary examination and passed the module, should have failed the Infections module if the directed learning mark had not increased their module marks. One of them had a second (supplementary) examination in three other modules, of which two were successful. The student failed one module (Cardiovascular System) and had to repeat the second academic year. No further follow-up on this student's progress has been performed.

The other student who successfully wrote the supplementary examination in the Infections module instead of downright failing the module, however, failed the Cardiovascular System module. Since he had already repeated his first academic year, he was not allowed to continue with his medical studies.

Questionnaire results: students' evaluation of e-MMFWF

From an overall perspective, students evaluated e-MMFWF as a very positive and meaningful experience. Selected results on their evaluation of e-MMFWF by means of a self-administered questionnaire were published before (Struwig et al., 2005). Results not published previously are shown in Figure 4.

Ninety-two percent of students indicated that the exposure to e-MMFWF made them realise that they still had a lot to learn about medical microbiology, while 89.7% was made aware of the extreme vastness of the subject as a field of study. Eighty-five percent of respondents were convinced that the exposure to e-MMFWF as compulsory directed learning made a positive contribution to the increase in their marks obtained in Test II.

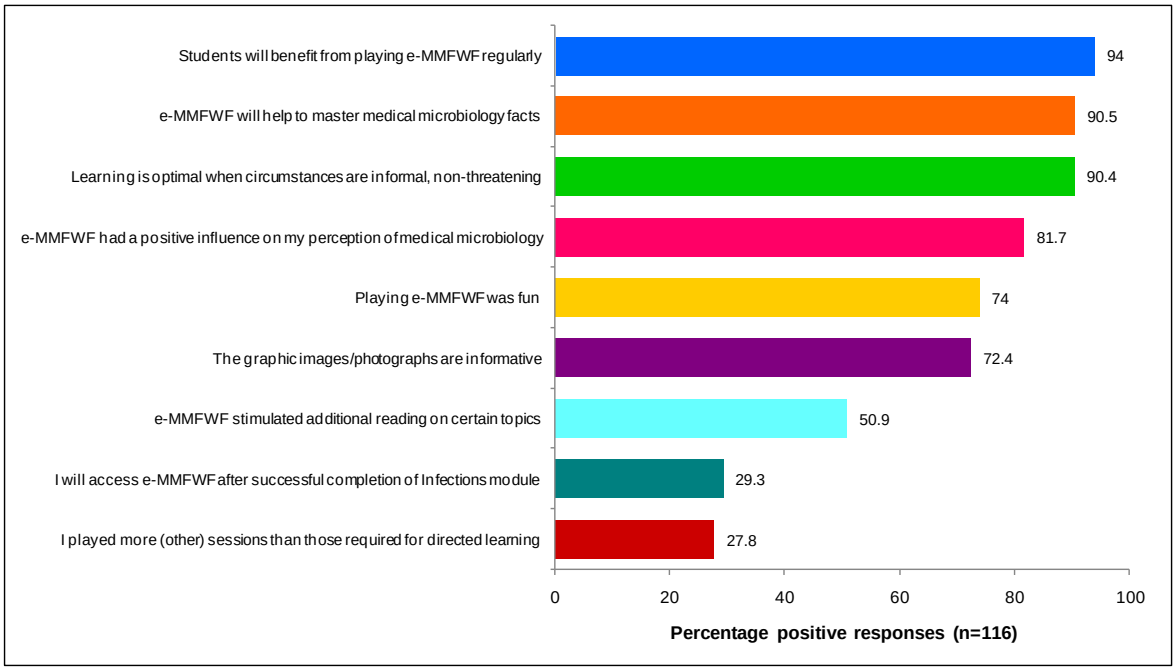

Figure 4. Students' positive feedback on selected aspects of e-MMFWF.

Open-ended questionnaire items invited suggestions and recommendations for the improvement of e-MMFWF, as well as any other comments that students wished to make. No negative responses to the open-ended questionnaire items were received. For the sake of presenting an unbiased, balanced report, and in order to illuminate that the students' experience of e-MMFWF was not exclusively positive, negative feedback received on the structured questionnaire items is shown in Figure 5.

Responses selected on the questionnaire as 'uncertain' are shown in addition to the responses representing 'yes' (complete agreement, or agreement to a fair degree). This was done to bring an awareness to the reader that the participants' outright negative experience of e-MMFWF could potentially have been higher, did they not have the 'uncertain' option on the questionnaire. From a more optimistic and confident viewpoint, however, respondents who chose this option might just as well then have selected a response reflecting a more positive experience.

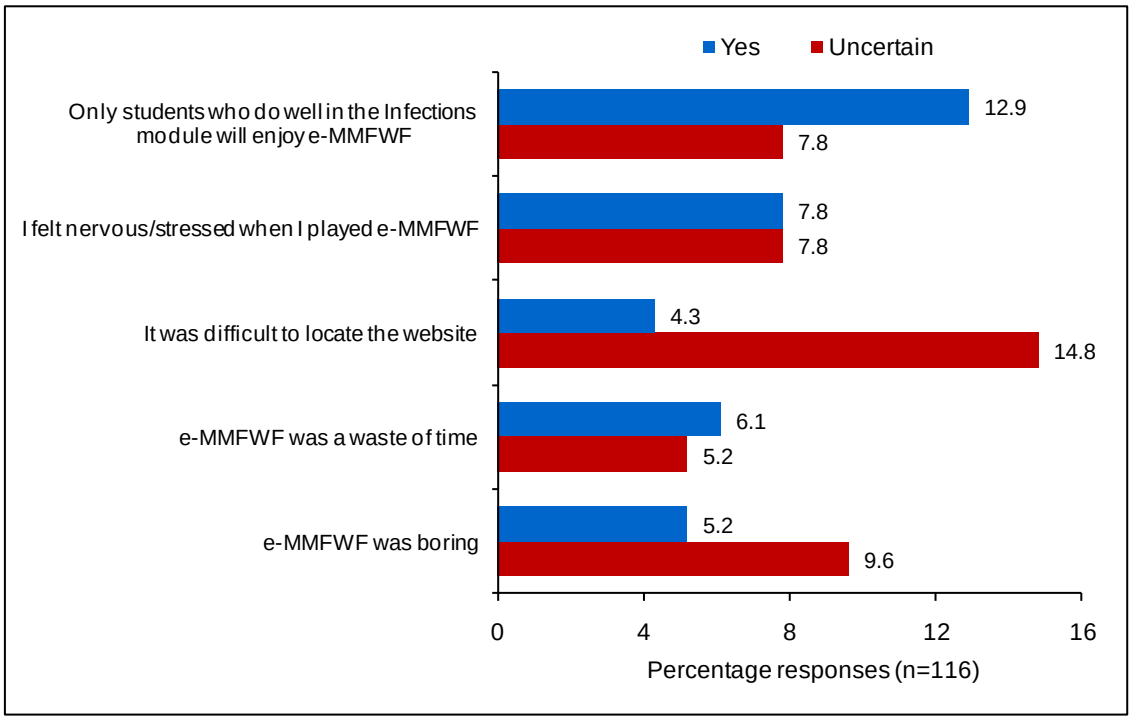

Figure 5. Students' feedback on negative aspects of e-MMFWF.

Although 81.7% of students indicated that e-MMFWF had a positive influence on their perception of medical microbiology, 20.7% of respondents were 'uncertain' whether playing the application made them feel more enthusiastic, and 13.8% gave a negative response to the questionnaire item pertaining to increased enthusiasm about medical microbiology.

Students who were either 'uncertain' (13%) whether they had fun, or gave an outright indication that they did not have fun playing e-MMFWF (13%), were initially considered as part of the 25% of students who said they did not like computer games in general. It was ascertained, however, that these two groups did not represent the same students.

A discrepancy noted in the questionnaire feedback merits attention. Sixty-eight percent of the participants agreed with the statement that accessing the e-MMFWF website on a regular basis would probably help them to develop lifelong learning skills in medical microbiology. However, only 29.3% indicated that they would access the website after successful completion of the Infections module.

The following remarks are representative of students' feedback on the open-ended questionnaire items requesting suggestions or recommendations for improvement or other comments:

- *The computer tests were an excellent innovation that has since enabled me to better my marks.*
- *Computer game was of great importance and benefit to me as it helped me understand module better…. Therefore, game be continued* (sic) *for betterment of coming students.*
- *I recommend that the computer tests are taken as a serious aspect of the module.*
- *The introduction of e-MMFWF was the most helpful method for the course. It made it easy to remember terms and new names.*
- *Thanks for the e-MMFWF programme…. Use this next year and you will see excellent results.*
- *e-MMFWF was particularly helpful in the mastering of facts.*
- *The microbiology game was extremely informative and helpful.*
- *Make the computer game compulsory; let it count 15% of the module mark.*

DISCUSSION

The implementation of e-MMFWF as a compulsory directed learning activity to address students' poor performance in Test I of the Infections module, was a once-off intervention that necessitates further investigation. Its positive impact on students' academic achievement in the module and their perception of medical microbiology in general, gives emphasis to the supposition that e-MMFWF could be employed successfully as a supplementary learning instrument in the module dealing with infectious diseases. In addition, e-MMFWF had a favourable influence on students' perception and experience of medical microbiology, while the majority (86.2%) were positive towards the prospect of play being employed in a meaningful way as a learning opportunity.

Based on the findings presented here, it could be construed that implementing e-MMFWF as a compulsory directed learning activity, and adapting the calculation of the module mark accordingly, did not distort the final outcome of the Infections module in any way. When the final results obtained in the Infections module were compared to the outcomes in the

other modules comprising the second semester, it was evident that students' performance in the Infections module was on par with the rest of their modules, with the exception of Immunology and Haematology, in which the mean final mark was 78% (cf. Figure 2). If this intervention had ***not*** been put into practice, several students who were deserving of either passing the module or obtaining a distinction, would have been deprived of the successful outcome they anticipated in view of their overall academic performance.

Since the majority of students played e-MMFWF more than the requisite number of times, it was difficult to ascertain whether the number of times the designated sessions were played had an influence on students' achievement in Test II of the Infections module.

The group of 22 students who passed the Infections module with distinction due to the positive impact that e-MMFWF had on their module marks, obtained between one and eight distinctions in other modules as well. Furthermore, these students all completed their medical studies within the minimum required number of years and graduated in December 2007. It could thus be argued that the distinctions they obtained in the Infections module were justified and deserved, especially when it is taken into consideration that 68.1% of this particular group of students passed at least one of their final-year modules with distinction.

Seventy-four percent of students indicated that it was fun to play e-MMFWF, as opposed to 90% of participants who had evaluated the board game version of MMFWF the previous year (Struwig et al., 2005). A possible explanation for this lesser degree of enjoyment could be that students who played the board game had already completed the Infections module successfully, while those who played the online version had to do it as compulsory directed learning in an effort to improve their marks. The online players still had to complete the Infections module, and the stress created by their overall poor performance in Test I of the module could probably contribute to a completely different approach to the activity.

Another explanation for the lesser extent of enjoyment experienced by the online players, is that playing the MMFWF board game occurred in small groups, with six students participating in each group. The groups consisted of three teams of two students each to allow for collaboration within teams as well as competition between teams. Group

dynamics were excellent when students played the board game, with 99% of participants reporting active group interaction, and 83% reporting spontaneous group discussion while play was taking place (Struwig et al., 2005). This feature was absent from e-MMFWF, which was played by students on an individual basis. It should be mentioned, however, that three students at one stage visited the module leader to discuss problems regarding the Infections module. As part of addressing their concerns, an informal session of playing e-MMFWF ensued in the module leader's office, and the spontaneous interaction, vibrant discussion and exchange of ideas and arguments that occurred in the process, was a most gratifying experience. Therefore, most probably all the positive attributes of playing the board game in small groups potentially also could have been experienced, should students collaboratively engage in e-MMFWF as an informal activity. This argument, however, is purely speculative.

Both groups (board game as well as online players) felt positive that play in general could be applied as a meaningful learning opportunity, although fewer online players (86.2%) agreed to this statement compared to the board game players (95%) (Struwig et al., 2005). This slight difference could probably also be ascribed to the lack of small group dynamics as argumented in the previous paragraph.

Games offer many advantages and have the potential to meet most of the characteristics of intrinsic motivation. Although the education profession has long been ambivalent about the value of games as an instructional tool or strategy, games and simulations are often employed in other educational settings, such as corporate and military training environments (Rieber 1996).

A notable number of studies reported in the literature endorse the use of games as supplementary learning tools in various disciplines of medicine (Bochennek, Wittekindt, Zimmerman & Klingebiel 2007; Duque, Fung, Mallet, Posel & Fleiszer 2008; Mann, Eidelson, Fukuchi, Nissman, Robertson & Jardines 2002; Rosser, Lynch, Cuddihy, Gentile, Klonsky & Merrell 2007; Skiba 2008; Zakaryan, Bliss & Sarvazyan 2005; Zisook, Benjamin, Balon, Glick, Louie, Moutier, Moyer, Santos & Servis 2005). The primary objective of utilising innovative techniques in teaching is to improve and maximise learning by making the process more fun for both the learners and the teacher (Handfield-Jones, Nasmith, Steinert & Lawn 1993). Medical educators are challenged not only by the

necessity to provide continuing education that supports excellence in clinical practice, but also to find innovative approaches to create learning opportunities that are more stimulating, motivating and entertaining. Many obstacles to learning can be overcome by exciting and atypical educational techniques (Howarth-Hockey & Stride 2002). As Lock (cited by Bandaranayake 2001:408) asserted 30 years ago in 1981,

> *[l]earning may be enhanced if a variety of presentation methods is used with students…. Learning occurs when students use a combination of senses.*

CONCLUSION

In conclusion, it could be stated irrefutably that playing e-MMFWF as part of these medical students' preparation for Test II of the Infections module, contributed positively to the improvement of their module marks and academic success in the module without distorting the distribution of their final marks. Furthermore, it also had a positive influence on their experience and perception of medical microbiology and infectious diseases as a basic preclinical science, judged by their agreement that e-MMFWF (and play in general) could be employed as a meaningful learning opportunity.

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PART IV

FINAL REFLECTION AND RECOMMENDATIONS

1 FINAL REFLECTION

Inevitably, most of this concluding part of the thesis is deeply personal. Going through the process of conceiving, planning and producing a medical microbiology game of the calibre described in Part II, was not an easy task. It was even more challenging to continuously invest an unlimited measure of emotional energy, passion and truly believing in the concept, not knowing for certain what the final outcome would be. It was a lonely road, especially when thinking back at the apparent lack of support from some colleagues who did not share my view on the importance of play in the learning process; colleagues who argued that 'studying medicine is a serious, often depressing business about life and death; you cannot have fun while learning all these sombre facts about disease and agony; there is only one way to master medicine, and that is to sit down and study, study, study…. in isolation …. and suffer'[1].

I do not believe that medical education should either be portrayed or experienced purely as torment and hardship. Yes, medicine is extremely challenging in many ways, and there will be heartbreaking situations when young doctors and sometimes even students have to face a patient for whom nothing more can be done, or parents who have lost a child in an accident. Clinical medicine *is* a serious matter which – regardless of the rewards associated with finding solutions for many patients' health problems or coming to a difficult diagnosis – mostly deals with pain and distress. However, preclinical training does not have to be dark and dreary, despite demanding tremendous discipline and commitment. Why not have fun in the process of mastering basic scientific knowledge, before the difficulties and sorrows of clinical medicine have to be dealt with? Enjoying the learning process, especially when real patients are not yet involved, surely is not equal to being disrespectful towards the solemn nature of illness.

[1] Referred to with all due respect and compassion, and not in a condescending way whatsoever.

Towards the completion of an endeavour such as the project described here, and in particular based on the arguments presented above, I have to ask myself a number of fundamental questions, such as,

- *Did I manage to achieve what I had in mind right at the beginning of the process, when frequently playing Trivial Pursuit™ led to the inspiration to make a board game for medical microbiology?*
- *Was it possible to change medical students' perception of the Infections module by means of the Med Micro Fun With Facts game?*
- *Does MMFWF have a future, and if so, where and how?*
- *Did I make a contribution with regard to the pedagogy of microbiology and infectious diseases, by enhancing the learning experience of undergraduate students who are easily overwhelmed by vast amounts of new information in unfamiliar subjects?*

I will attempt to answer these questions directed to myself as frankly as possible. If I had failed in my effort to convince students that medical microbiology can be an exciting field of study, then – in complete agreement with Dorothy de Zouche (1945) – I should have cleaned up my desk, dumped all my textbooks in boxes, closed my office door and gone home, knowing that I could not make a difference.

1.1 Did I manage to achieve what I had in mind at the beginning of the process?

Depending on the context and circumstances, success can be seen as making every effort to develop an initiative into a tangible result. First and foremost, I was able to put the final product – the MMFWF board game – on the table. I am positive that medical microbiology facts can indeed be learnt by means of playing a game and enjoying it as part of the learning process. Play, as an inherent part of human nature, can be employed in learning situations at any stage of a person's life.

I further believe that a game approach can be applied successfully to numerous fields of study, from the history of art and music, geography and psychology, to physics, chemistry and – with sufficient effort and insight – even mathematics. Play offers a unique and rewarding learning opportunity in any discipline where the mastering of basic facts is required before the student

can proceed to complex activities such as reasoning, arguing, defending points of view, and speculating – not only on a personal basis, but especially in the process of sharing knowledge and ideas with fellow students or colleagues.

1.2 Did students' perception of medical microbiology change as a result of playing MMFWF?

Based on the feedback obtained by means of the questionnaire surveys conducted after students had played either the board game or e-MMFWF, it could be concluded that both versions of the game contributed considerably to a change in students' perception of medical microbiology. Exposure to the subject content by means of playing either one of these versions of the game, resulted in students feeling more enthusiastic about the Infections module and medical microbiology in general. Furthermore, they were positive about play as an approach to learning. Although the game made them realise the vast extent of medical microbiology and infectious diseases as a field of study, they agreed that dealing with the content of the game in a relaxed, non-threatening and healthy competitive way, promoted learning and understanding of the subject content.

I can therefore conclude with confidence that the groups of students who were exposed to the content of the Infections module by means of playing MMFWF, afterwards felt more positive towards the subject. Where they were overwhelmed by and confused about medical microbiology before playing the game, the informal contact with the factual content of the subject in a healthy competitive, interactive and highly enjoyable setting shared with peers, reduced their level of despondency and a view of Infections as 'just another difficult module to pass so that I can continue with my academic career'.

1.3 Does MMFWF have a future, and if so, where and how?

When MMFWF was shown and explained on an informal basis to colleagues, students, friends and acquaintances, and even respected senior medical microbiologists[2] from other universities, the game was commended by all of them as a potentially valuable and useful learning tool in

[2] With specific reference to Professors Heather Crewe-Brown and Mike Dove, former heads of the Department of Medical Microbiology at the Universities of the Witwatersrand and Pretoria, respectively.

medical microbiology. The overwhelmingly positive response from lay persons as well as experts in the field of infectious diseases and other medical disciplines, may be taken as confirmation that MMFWF can indeed be used by medical students to master the factual content of the subject.

It can thus be argued that MMFWF not only has a justifiable place in future medical education, but also that it can be used in a broad spectrum of settings, should the practical implementation of the recommendations listed below be seriously considered.

1.4 Did I make a contribution with regard to the pedagogy of microbiology and infectious diseases?

In comparison to the relatively few games currently available on specialised topics in medical microbiology and infectious diseases (see Part I, section 6.7.2, *Educational games with a focus on medical microbiology and infectious diseases*), MMFWF is unique in several ways. Firstly, it covered the whole spectrum of the discipline instead of focusing on one selected issue, such as host defence in response to pathogens, or the mechanisms of action of different antimicrobial agents. Furthermore, the objective of the game was not primarily to improve students' factual knowledge of the subject, but to bring about a positive change in their perception of and attitude towards medical microbiology as an important part of their medical training.

This study thus investigated the students' experience of the game from a much wider perspective than merely the expansion of their knowledge. In addition to the influence of the game on their attitudes and perceptions, exposure to the information presented in the question-and-answer database provoked a meta-cognitive awareness with regard to their personal limitations in the field. Not only did they realise the vast extent of medical microbiology as a subject, but also how much they still had to learn about infectious diseases despite successful completion of the Infections module; and to what extent the knowledge acquired in the module was lost over a short period of time. Many of them acknowledged that when qualified and practicing as a doctor, they would have to continue learning to keep themselves up-to-date with regard to new developments in infectious diseases.

Playing the MMFWF game brought students to the important realisation that medical microbiology is not a static discipline that can be seen as 'fully mastered' after completion of the module. They realised that not everything currently known in a field of study can be dealt with thoroughly in an undergraduate curriculum, and that new developments in diagnostic techniques and treatment options are reported continually.

Being an optimist, often to the extreme of being irrationally passionate, I believe that the students who were exposed to the MMFWF game – as well as those who will hopefully play it in future – will continue to be aware of the importance of two key aspects of the learning process: (i) that play enhances the quality of the learning experience and the retention of knowledge acquired in the process; and (ii) that curiosity is one of the most powerful driving forces in humankind's quest for intellectual progress and, consequently, social improvement and providing a better community for all.

2 RECOMMENDATIONS

From the research findings, a number of recommendations can be proposed for the practical application of the MMFWF game.

- In the context of the School of Medicine at the UFS, the MMFWF board game can be used as part of group work in the Infections module of the medical curriculum. In addition to mastering the factual content of the subject, the development and improvement of skills such as communication, articulation of difficult terminology, exchange of knowledge, teamwork, and learning from more capable peers or tutors, will be promoted.

- Based on feedback acquired from both staff and students who evaluated the board game as a learning instrument, compiling smaller sets of question-and-answer cards that focus on specific sessions of the module is recommended. Students will then be able to play the game, for example, on a two-weekly basis to revise the work dealt with in the preceding two sessions of the module.

- Categorisation of the subject content can be approached from a system-specific angle, with categories focusing on infections of specific body systems. Questions can then, for example, be divided into gastrointestinal, respiratory, central nervous system, urogenital, skin, bone and soft tissue infections, and so forth. Each of the system-specific categories can include questions dealing with the different causative organisms involved in these specific infections, their clinical and laboratory diagnosis, treatment and prevention.

- In addition to the current categories in the online version of the game [dealing with either bacteriology, virology, mycology, parasitology, diagnosis and treatment of infectious diseases, or Sessions 1–14; see Exhibit 7(a), p. 82], e-MMFWF can also be presented in system-specific categories.

- The game can be used as a valuable 'refresher' activity in microbiology and infectious diseases by senior medical students busy with Phase III (clinical training) of the undergraduate curriculum.

- The concept of a multi-category, quiz-type game can be applied to different disciplines in the study of medicine. Most fields of study can potentially be categorised into different topics. Pharmacology, for example, can be divided into categories dealing with different groups of pharmaceutical agents, such as drugs specifically used for the treatment of hypertension, diabetes, epilepsy, inflammatory conditions or psychiatric disorders. Antimicrobial agents, which are dealt with in both the disciplines of pharmacology and infectious diseases, can be categorised into antibacterial, antiviral, antifungal and antiparasitic drugs. Categories such as contraindications and adverse effects of drugs may also be included.

- Use of the game does not have to be limited to the School of Medicine at the UFS. Copies of the board game can be made available to other medical schools and departments of medical microbiology at a reasonable cost. It should be kept in mind, however, that the manual production of a game set is very time-consuming and labour-intensive, and the ideal would be to employ a games manufacturing company to become involved in the production of multiple sets of the MMFWF board game. With

regard to e-MMFWF, the web address required to log in on the game can be made available to students of other medical schools.

- The MMFWF game can be used as a learning tool in different areas of study where knowledge of medical microbiology and infectious diseases is required, for example, by students in medical technology, medical scientists and registrars in medical microbiology and/or virology, and even registrars in internal medicine with a particular interest in infectious diseases.

- The e-MMFWF version of the game can be employed as a continuous professional development (CPD) activity to be used by general practitioners, consultants, pathologists, medical technologists and scientists for whom the acquisition of CPD points is required by the HPCSA. MMFWF as a CPD activity can be approached and presented in a way similar to other online CPD activities currently available. The necessary information and instructions to access the game as a CPD activity can be posted in locally available journals, such as *South African Family Practice (SAFP), South African Medical Journal (SAMJ), Southern African Journal of Epidemiology and Infection (SAJEI),* and *African Journal of Primary Health Care and Family Medicine (PHCFM).*

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SUMMARY

In this research, play was used to address negative perceptions about medical microbiology in the MBChB course. The Infections module is part of the second academic year in the MBChB curriculum at the University of the Free State (UFS), Bloemfontein, South Africa. Students' negative perception of medical microbiology and infectious diseases was identified by the researcher, who had been a lecturer in the module for many years. In an attempt to address students' complaints and dissatisfaction regarding the huge volume of work dealt with in the module, exposure to new terminology, and the complicated classification and nomenclature of microorganisms, the researcher resorted to investigating enjoyable forms of learning as a potential solution.

Play is regarded by developmental and educational psychologists as an inherent part of human nature, which is employed in various settings and circumstances in the process of acquiring knowledge, information and skills necessary for social adaptation, integration and survival. The benefits of play are not limited to childhood – play can be enjoyed by individuals of any age, throughout their lives. Educational games are recognised as meaningful and effective teaching and learning instruments – also in higher education and medical training. Incorporating a fun component and positive affect into the learning process is known to promote intrinsic motivation, enhance quality of learning, and lead to better retention of knowledge.

The researcher developed a quiz-style board game, Med Micro Fun With Facts (MMFWF), based on the principles of Trivial Pursuit™. MMFWF can be used as a supplementary group work activity to expose students to the factual content of the vast discipline of microbiology in a non-threatening, healthy competitive environment. The game contains 700 colour-coded questions and answers divided into seven corresponding colour-coded categories, each containing 100 questions and answers. Six categories cover microbiological topics (bacteriology, virology, mycology, parasitology, and the diagnosis and treatment of infectious diseases), while a category on general medicine was included to prevent the potential risk of feeling overwhelmed or becoming bored by the numerous medical microbiology facts.

The MMFWF board game was introduced to medical students shortly after they had successfully completed the Infections module. The game was evaluated by students by means of a self-administered, anonymous questionnaire and semi-structured focus group interviews, and by academic members of staff by means of direct observation of the play process and nominal group interviews. The overall feedback showed that both students and staff had a highly positive experience of MMFWF, and regarded it as a meaningful approach to mastering the factual content of medical microbiology. The students indicated that playing the game had a positive influence on their perception of and attitude towards the subject.

The MMFWF board game was also converted into a multiple-choice web-based application (e-MMFWF), which was implemented as a compulsory directed learning activity in the Infections module. The students played e-MMFWF as part of their preparation for the forthcoming second semester test. The class average increased by 22% from Test I to Test II, and many students who were facing the possibility of failing an academic year due to poor performance in the Infections module were able to successfully complete their studies at their expected level of accomplishment. Eighty-five percent of the students who played e-MMFWF in preparation for semester Test II indicated their conviction that the directed learning activity contributed positively to the improvement in their test marks.

The positive feedback on the MMFWF board game as a learning tool in medical microbiology, and students' improved marks after playing e-MMFWF, show that MMFWF can be used with good results as a supplementary learning modality in the Infections module of the undergraduate medical training programme.

OPSOMMING

In hierdie studie is spel aangewend om negatiewe persepsies oor mediese mikrobiologie in MBChB-studies aan te spreek. Die Infeksies-module is deel van die tweede akademiese jaar in die MBChB-kurrikulum aan die Universiteit van die Vrystaat in Bloemfontein, Suid-Afrika. Die navorser, wat vir baie jare 'n dosent in die module was, het 'n negatiewe persepsie van mediese mikrobiologie en infektiewe siektes onder studente geïdentifiseer. In 'n poging om hul klagtes en ontevredenheid oor die groot volume werk wat in die module behandel word, die blootstelling aan nuwe terminologie, en die komplekse klassifikasie en nomenklatuur van mikroörganismes aan te spreek, het die navorser haar tot die ondersoek van genotvolle leervorme as 'n potensiële oplossing gewend.

Spel word deur ontwikkelings- en opvoedkundige sielkundiges as 'n inherente deel van die menslike natuur beskou, en word in verskeie omgewings en omstandighede gebruik in die verkryging van kennis, inligting en sosiale aanpassings-, integrasie- en oorlewings-vaardighede. Die voordele van spel is nie tot die kinderjare beperk nie – individue van enige ouderdom kan spel dwarsdeur hul lewens geniet. Opvoedkundige speletjies word erken as betekenisvolle en doeltreffende onderrig- en leerinstrumente – ook in hoër onderwys en mediese opleiding. Dit is 'n bekende feit dat die insluiting van 'n pret-komponent en positiewe affek in die leerproses intrinsieke motivering, beter leerkwaliteit en die retensie van kennis bevorder.

Die navorser het 'n vasvra-tipe bordspel, *Med Micro Fun With Facts* (MMFWF), wat op die beginsels van Trivial Pursuit™ gebaseer is, ontwikkel. MMFWF kan as 'n aanvullende groepwerkaktiwiteit gebruik word om studente in 'n nie-bedreigende, gesonde kompeterende omgewing aan die feitelike inhoud van die omvangryke dissipline van mikrobiologie bloot te stel. Die speletjie bevat 700 kleur-gekodeerde vrae en antwoorde, wat in sewe ooreenstemmende kleur-gekodeerde kategorieë, elk met 100 vrae en antwoorde, ingedeel is. Ses kategorieë dek mikrobiologie-onderwerpe (bakteriologie, virologie, mikologie, parasitologie, die diagnose en behandeling van infektiewe), terwyl 'n kategorie oor algemene geneeskunde ingesluit is om te verhoed dat studente deur die talle mediese mikrobiologie feite oorweldig voel, of verveeld raak.

Die MMFWF-bordspel is aan mediese studente bekendgestel kort nadat hulle die Infeksies-module suksesvol afgelê het. Die studente het die speletjie met behulp van 'n self-toegepaste, anonieme vraelys en semi-gestruktureerde fokusgroep-onderhoude geëvalueer, terwyl akademiese personeel dit met behulp van direkte waarneming van die speelproses en nominale groeponderhoude geëvalueer het. Die geheelindruk wat verkry is uit die terugvoer van die studente sowel as die personeel, is dat MMFWF vir hulle 'n baie positiewe belewenis was, en dat hulle dit as 'n betekenisvolle benadering tot die bemeestering van die feitlike inhoud van mediese mikrobiologie beskou. Die studente het aangedui dat die speel van die bordspel 'n positiewe invloed op hulle persepsie van, en gesindheid teenoor die vak gehad het.

Die MMFWF-bordspel is ook omgeskakel na 'n veelvuldige-keuse web-gebaseerde applikasie (e-MMFWF), wat as 'n verpligte gerigte leeraktiwiteit in die Infeksies-module aangewend is. Die studente het e-MMFWF as deel van hul voorbereiding vir die tweede semestertoets gespeel. Die klasgemiddeld het met 22% van Toets I na Toets II gestyg, en talle studente wat die moontlikheid in die gesig gestaar het om 'n akademiese jaar as gevolg van swak prestasie in die Infeksies-module te druip, kon hul studies op hul verwagte prestasievlak voltooi. Vyf-en-tagtig persent van die studente wat e-MMFWF ter voorbereiding van Semestertoets II gespeel het, was oortuig dat die gerigte leeraktiwiteit positief tot die verbetering in hulle punte bygedra het.

Die positiewe terugvoer oor die MMFWF-bordspel as 'n leerinstrument in mediese mikrobiologie, asook die verbetering in studente se punte nadat hulle e-MMFWF gespeel het, toon dat MMFWF met goeie gevolg as 'n aanvullende leermodaliteit in die Infeksies-module van die voorgraadse mediese opleidingsprogram gebruik kan word.

KEY TERMS

Medical education

Medical microbiology

Infectious diseases

Play

Educational games

Motivation

Enthusiasm

Learning environment

Interactive learning

Competition

General skills

Innovation

Learning instrument

APPENDIX A

UNIVERSITY OF THE FREE STATE
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF MEDICAL MICROBIOLOGY
DIVISION OF EDUCATIONAL DEVELOPMENT

QUESTIONNAIRE I

QUESTIONNAIRE TO M.B.,Ch.B. III STUDENTS IN THE FACULTY OF HEALTH SCIENCES, UNIVERSITY OF THE FREE STATE, BLOEMFONTEIN, WITH REGARD TO (a) LEARNING STRATEGIES AND THE PROCESSING OF INFORMATION/SUBJECT CONTENT, AND (b) PERCEPTIONS OF AND ATTITUDES TOWARDS THE SUBJECT MEDICAL MICROBIOLOGY (MODULE MJR 224: INFECTIONS)

This questionnaire consists of four sections, *viz.:*

(i) SECTION A: General and biographical information
(ii) SECTION B: Self-regulating learning strategies
(iii) SECTION C: Perceptions of and attitudes towards the subject medical microbiology
(iv) SECTION D: Processing of information/subject content

GENERAL INFORMATION FOR COMPLETION OF THE QUESTIONNAIRE

1. This questionnaire consists of 11 pages. Its completion should not require more than 30–40 minutes of your time.

2. Your response will be analyzed and applied for research in the field of Health Professions Education (HPE), with specific reference to students' perceptions of and attitudes towards medical microbiology as a basic, preclinical, biomedical science and learning strategies applied by students to process and master the subject content.

3. The questionnaire is completed anonymously and its content is regarded as strictly confidential. The information acquired by means of this questionnaire is the intellectual property of University of the Free State and will be used in a research project conducted by the researcher to obtain the degree Ph. D. (Health Professions Education).

4. This questionnaire is NOT an evaluation of yourself as a student and due to its anonymity, your academic achievement in MJR 224 (Infections) cannot be taken into account in analyzing the data obtained.

5. The useful and meaningful application of the information obtained by means of this questionnaire depends on your correct, **honest** and thorough completion thereof.

Thank you for your co-operation. ***PLEASE BE ASSURED THAT IT IS SINCERELY APPRECIATED.***

_____

M. C. STRUWIG

[**NOTE:** This questionnaire has been adapted with permission from Du Toit E. R. (1999). *'n Uitkomsgerigte model vir biologieonderwys met die fokus op selfregulerende leer. (An outcomes-based model for biology education with the focus on self-regulating learning).* Ph. D. thesis. Bloemfontein: University of the Free State.]

SECTION A GENERAL AND BIOGRAPHICAL INFORMATION ***FOR OFFICE USE***

☐☐☐ 1-3

Mark the number (X) corresponding to the statement that applies to you.

Example:

I enjoy attending a rugby match.	**1**
I enjoy attending a symphony concert.	**2**

1. Gender

Male	**1**
Female	**2**

☐ 4

2. Home language

Afrikaans	**1**
English	**2**
Northern Sotho	**3**
Southern Sotho	**4**
Tswana	**5**
Xhosa	**6**
Zulu	**7**
Other (if **other**, please specify below)	**8**

☐ 5

Other language: _____

3. Did you repeat the second year?

Yes	**1**
No	**2**

☐ 6

4. Which class did you attend?

Afrikaans	**1**
English	**2**

☐ 7

5. Do you have a post-school qualification? (e.g. B.A., B.Sc.)

Yes (if **yes**, please specify below)	**1**
No	**2**

☐ 8

☐☐ 9-10

Post-school qualification(s): _____

6. Where do you live while studying?

In a residence on campus	**1**
Alone in a flat/town-house/house	**2**
Sharing a flat/town-house/house with other students	**3**
With my parents/other family	**4**
Other (if **other**, please specify below)	**5**

☐ 11

Other place of living: _____

7. Would you regard your living conditions as positive with regard to promoting a learning atmosphere?

Yes	**1**
No (if **no**, please complete **item 8**)	**2**

☐ 12

FOR OFFICE USE

8. Select <u>ALL the reasons</u> that apply to the circumstances of your living conditions that do NOT promote learning.

I have trouble to adapt since I have left home.	**1**
My house-/flat mate(s) keep me from my work.	**2**
I don't get along with my house-/flat mate(s).	**3**
My house-/flat mate(s) have parties too often.	**4**
My house-/flat mates listen to loud music when I want to study.	**5**
My standard of living is not the same as that to which I was used while still living at home.	**6**
I am worried about financial pressure I experience as a result of the place where I'm living.	**7**
Other (if **other**, please specify below)	**8**

☐ 13
☐ 14
☐ 15
☐ 16
☐ 17
☐ 18
☐ 19
☐ 20

Other reasons why my place of living does not promote learning:

_____

_____

9. Are you a member of an active study group?

Yes	**1**
No	**2**

☐ 21

10. Do you have any pastime activities/hobbies?

Yes (if **yes**, please complete **item 11**)	**1**
No	**2**

☐ 22

11. Select your <u>FIVE</u> most favourite pastime activities/hobbies from the list provided below.

Reading	**1**
Writing (*e.g.* short stories, poetry)	**2**
Watching television	**3**
Sport (as a **spectator**)	**4**
Sport (as a **participant**)	**5**
Art (*e.g.* painting, sculpture, pottery, woodcarving, going to exhibitions)	**6**
Classical music (as a **listener**)	**7**
Classical music (as a **solo/orchestral participant**)	**8**
Contemporary music (as a **listener**)	**9**
Contemporary music (as a **solo/band participant**)	**10**
Hanging out with friends	**11**
Volunteer working for charity organizations	**12**
Church/religious activities	**13**
Internet surfing	**14**
Woodwork	**15**
Needlework	**16**
Going to the movies	**17**
Other (if **other**, please specify below)	**18**

☐☐ 23-24
☐☐ 25-26
☐☐ 27-28
☐☐ 29-30
☐☐ 31-32

☐☐ 33-34
☐☐ 35-36
☐☐ 37-38

Other pastime activities/hobbies not listed: _____

_____

_____

SECTION B SELF-REGULATING LEARNING STRATEGIES

The purpose of the following items is to investigate different aspects regarding self-regulating learning strategies as applied by the student in medical microbiology (henceforth referred to as "med micro").

If the statement ***never/almost never*** applies to you, make a cross (X) over ***1.***
If the statement ***sometimes*** applies to you, make a X over ***2.***
If you are ***uncertain***, make a X over ***3.***
If the statement ***often (usually)*** applies to you, make a X over ***4.***
If the statement ***always/almost always*** applies to you, make a X over ***5.***

1 never/almost never	**2 sometimes**	**3 uncertain**	**4 often (usually)**	**5 always/almost always**

								For office use	
1	When I studied for a test, I used the information given in the lecture/session as well as my med micro text book.	**1**	**2**	**3**	**4**	**5**			1
2	When I did my assignments/directed learning, I tried to remember what the med micro lecturer(s) said in class, because that would help me to do my work properly/correct.	**1**	**2**	**3**	**4**	**5**			2
3	I continuously asked myself questions to determine whether I knew the med micro material I was busy studying.	**1**	**2**	**3**	**4**	**5**			3
4	It was difficult to determine for myself what the most important aspects of med micro were that I had to know.	**1**	**2**	**3**	**4**	**5**			4
5	When the med micro study material was too difficult, I gave up and learned only the easier parts.	**1**	**2**	**3**	**4**	**5**			5
6	When I studied med micro, I tried to replace the more difficult parts with my own words.	**1**	**2**	**3**	**4**	**5**			6
7	I always tried to understand what the med micro lecturer(s) said even if it didn't really make sense.	**1**	**2**	**3**	**4**	**5**			7
8	When I studied for a med micro test, I tried to remember as many facts as possible.	**1**	**2**	**3**	**4**	**5**			8
9	When I studied med micro, I wrote down my notes/ summaries over and over to help me remember the facts.	**1**	**2**	**3**	**4**	**5**			9
10	I often completed the questions/exercises at the end of the chapters in my med micro text book even when it was not required of me.	**1**	**2**	**3**	**4**	**5**			10
11	Even when the med micro study material was not interesting, I worked until my assignments were finished.	**1**	**2**	**3**	**4**	**5**			11
12	When I studied for a med micro test, I repeated the facts over an over to myself.	**1**	**2**	**3**	**4**	**5**			12
13	I thought about everything I would need (*e.g.* pens, colored pencils, summaries) before I started studying med micro.	**1**	**2**	**3**	**4**	**5**			13
14	I used information from previous assignments as well as the text book to do new assignments in med micro.	**1**	**2**	**3**	**4**	**5**			14
15	I have often read facts/definitions in med micro without really understanding it.	**1**	**2**	**3**	**4**	**5**			15
16	I often thought about other things and didn't listen when the med micro lecturer was presenting a session.	**1**	**2**	**3**	**4**	**5**			16

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

								For office use	
17	When I studied a specific topic in med micro, I tried to fit all the aspects together.	**1**	**2**	**3**	**4**	**5**			17
18	When I studied med micro, I often stopped to go over the work again that I finished.	**1**	**2**	**3**	**4**	**5**			18
19	When I prepared for a med micro test/exam, I said the words over and over to myself to help me remember.	**1**	**2**	**3**	**4**	**5**			19
20	I compiled a scheme/diagram/table of the topics covered in each med micro session to help me remember.	**1**	**2**	**3**	**4**	**5**			20
21	I worked hard in med micro to obtain good marks, although I didn't enjoy the classes.	**1**	**2**	**3**	**4**	**5**			21
22	When I read med micro study material, I tried to relate new information to work that I already knew.	**1**	**2**	**3**	**4**	**5**			22
23	I started studying for med micro tests two weeks in advance.	**1**	**2**	**3**	**4**	**5**			23
24	I made use of the library and other sources (*e.g.* the internet) to obtain more knowledge on med micro.	**1**	**2**	**3**	**4**	**5**			24
25	I made a list of terminology that I didn't know/understand to look it up at a later stage.	**1**	**2**	**3**	**4**	**5**			25
26	I made notes in the med micro sessions is addition to the study material I received.	**1**	**2**	**3**	**4**	**5**			26
27	I isolated myself from everything that could interfere with my concentration when I studied med micro.	**1**	**2**	**3**	**4**	**5**			27
28	When I achieved my goal and did well in a med micro test, I rewarded myself in some way (*e.g.* taking an afternoon off, going to a movie).	**1**	**2**	**3**	**4**	**5**			28
29	When I experienced a problem with med micro, I asked a lecturer or a fellow student for help.	**1**	**2**	**3**	**4**	**5**			29
30	The ONLY reason why I learned med micro, was because it is a compulsory module that I had to pass.	**1**	**2**	**3**	**4**	**5**			30
31	When I experienced problems with med micro, I tried to find a solution to solve them.	**1**	**2**	**3**	**4**	**5**			31
32	I would have preferred to learn med micro in a more relaxed, informal way.	**1**	**2**	**3**	**4**	**5**			32
33	Enthusiasm and intrinsic motivation are more important to develop into a lifelong learner in med micro than intellectual ability or academic achievement.	**1**	**2**	**3**	**4**	**5**			33
34	I felt guilty when I took time off to do something with my friends instead of studying med micro.	**1**	**2**	**3**	**4**	**5**			34
35	I learned more about med micro on my own than in a small group discussion during formal sessions.	**1**	**2**	**3**	**4**	**5**			35
36	I learned med micro by "teaching" imaginary or fellow students.	**1**	**2**	**3**	**4**	**5**			36

SECTION C PERCEPTIONS OF AND ATTITUDES TOWARDS THE SUBJECT MEDICAL MICROBIOLOGY (MODULE MJR 224: INFECTIONS)

The purpose of this section is to obtain information with regard to your perception of and attitude towards medical microbiology/MJR 224: Infections (henceforth referred to as "med micro") as a compulsory module in the undergraduate medical curriculum. Analysis of these responses will enable the researcher to determine if there are any obstacles from the students' point of view that prevent them from obtaining satisfactory academic achievement in the subject.

If the statement ***never/almost never*** applies to you, make a cross (X) over ***1.***
If the statement ***sometimes*** applies to you, make a X over ***2.***
If you are ***uncertain***, make a X over ***3.***
If the statement ***often (usually)*** applies to you, make a X over ***4.***
If the statement ***always/almost always*** applies to you, make a X over ***5.***

1 never/almost never	**2 sometimes**	**3 uncertain**	**4 often (usually)**	**5 always/almost always**

								For office use	
1	I liked/enjoyed med micro as a subject.	**1**	**2**	**3**	**4**	**5**			1
2	I felt anxious when I had to write a test/exam in med micro.	**1**	**2**	**3**	**4**	**5**			2
3	When I got behind in med micro, I made an extra effort to catch up with my work.	**1**	**2**	**3**	**4**	**5**			3
4	I explained what I learned in med micro to my friends, parents and other persons.	**1**	**2**	**3**	**4**	**5**			4
5	The med micro lecturers used terminology that I didn't understand and that confused me.	**1**	**2**	**3**	**4**	**5**			5
6	I know my abilities in med micro were good.	**1**	**2**	**3**	**4**	**5**			6
7	When I had to study med micro/do assignments, I became nervous.	**1**	**2**	**3**	**4**	**5**			7
8	I assessed myself orally and/or by means of written "tests" on the work that I studied in med micro.	**1**	**2**	**3**	**4**	**5**			8
9	I can think of examples where I could apply the knowledge I obtained on med micro.	**1**	**2**	**3**	**4**	**5**			9
10	I liked the place (setting/venue/study area) where I studied for med micro tests and exams.	**1**	**2**	**3**	**4**	**5**			10
11	When the med micro lecture/session was boring, I lost interest and did things (*e.g.* scribbled notes to my friends) to pass the time.	**1**	**2**	**3**	**4**	**5**			11
12	I could not express myself very well when I suddenly had to answer a question on med micro.	**1**	**2**	**3**	**4**	**5**			12
13	I postponed my med micro directed learning/self-study assignments to do something more interesting.	**1**	**2**	**3**	**4**	**5**			13
14	I knew what to do when I had to find solutions or analyze results in med micro.	**1**	**2**	**3**	**4**	**5**			14
15	Dissatisfaction and/or frustration prevented me from working as hard in med micro as I should have.	**1**	**2**	**3**	**4**	**5**			15
16	I think all the topics in med micro were meaningful.	**1**	**2**	**3**	**4**	**5**			16

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

								For office use	
17	I lost marks in med micro tests/exams because I deleted/ scratched out correct answers.	**1**	**2**	**3**	**4**	**5**			17
18	I repeatedly read through a problem/difficult part of the med micro study material until I fully understood it.	**1**	**2**	**3**	**4**	**5**			18
19	I tried to find a link/relationship between the different sections of med micro.	**1**	**2**	**3**	**4**	**5**			19
20	I was too scared to ask the lecturer(s) questions about med micro.	**1**	**2**	**3**	**4**	**5**			20
21	It was more important to me to understand certain concepts in med micro than just knowing the content.	**1**	**2**	**3**	**4**	**5**			21
22	When I could not participate in a conversation with my friends on certain aspects of med micro, I felt anxious.	**1**	**2**	**3**	**4**	**5**			22
23	I tried to keep my med micro up to date by studying the new work thoroughly each week.	**1**	**2**	**3**	**4**	**5**			23
24	I tried as hard as possible to find easier solutions to problems in med micro that I didn't understand.	**1**	**2**	**3**	**4**	**5**			24
25	I asked the lecturer(s) for help with assignments that were not clear.	**1**	**2**	**3**	**4**	**5**			25
26	I solved all problems in med micro by applying the steps of problem solving*.	**1**	**2**	**3**	**4**	**5**			26
27	When we had to do group assignments in med micro, I also tried to get solutions/answers.	**1**	**2**	**3**	**4**	**5**			27
28	I always paid attention in the med micro sessions.	**1**	**2**	**3**	**4**	**5**			28
29	I became very nervous when I didn't understand what the lecturer was explaining.	**1**	**2**	**3**	**4**	**5**			29
30	It was important to me to find the meanings of concepts/ terms in med micro that I didn't understand.	**1**	**2**	**3**	**4**	**5**			30
31	I found it easy to express myself in a med micro test/exam.	**1**	**2**	**3**	**4**	**5**			31
32	It was somebody else's (*e.g.* the lecturers'/my friends') fault that I didn't work hard enough in med micro.	**1**	**2**	**3**	**4**	**5**			32
33	I lost marks in med micro tests/exams because I worked too slow or too fast (over-hasty).	**1**	**2**	**3**	**4**	**5**			33
34	I postponed my med micro assignments/directed learning to do something else.	**1**	**2**	**3**	**4**	**5**			34
35	I try to apply in my daily living what I have learned in med micro.	**1**	**2**	**3**	**4**	**5**			35
36	I have problems with my hearing/vision, but I didn't have the courage to move to a better seat.	**1**	**2**	**3**	**4**	**5**			36
37	After some time of studying I found it difficult to concentrate on med micro.	**1**	**2**	**3**	**4**	**5**			37

* Steps of problem solving: (1) read the problem and clarify terminology; (2) re-formulate the problem in your own words; (3) formulate study objectives; (4) apply appropriate learning strategies to reach objectives; (5) determine by self-assessment whether objectives were achieved.

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

							For office use	
38	When I did med micro (assignments/studying) I became drowsy, tired or irritable.	**1**	**2**	**3**	**4**	**5**		38
39	I followed up on all the mistakes I made in med micro tests.	**1**	**2**	**3**	**4**	**5**		39
40	I did poorly in med micro because of my domestic circumstances.	**1**	**2**	**3**	**4**	**5**		40
41	I formed a picture as a whole of the work I had to learn before I started studying for a med micro test/exam.	**1**	**2**	**3**	**4**	**5**		41
42	I felt enthusiastic about med micro.	**1**	**2**	**3**	**4**	**5**		42
43	Although I realized that the med micro module was not covering every detail of the subject, I knew what I had to learn was important.	**1**	**2**	**3**	**4**	**5**		43
44	I learned all definitions and med micro facts/detail by heart.	**1**	**2**	**3**	**4**	**5**		44
45	When I didn't understand the work in med micro, I tried to approach it from a different perspective until it made sense.	**1**	**2**	**3**	**4**	**5**		45
46	I didn't understand certain concepts in med micro.	**1**	**2**	**3**	**4**	**5**		46
47	I know it is important to use my knowledge of med micro.	**1**	**2**	**3**	**4**	**5**		47
48	I made my diagrams/tables/summaries bright and colourful so that it would stand out more clearly.	**1**	**2**	**3**	**4**	**5**		48
49	I sometimes stopped reading in the middle of a paragraph to make sure that I understood what I have read.	**1**	**2**	**3**	**4**	**5**		49
50	I was uncertain whether my med micro assignments/directed learning were correct, but I hesitated to ask the lecturer.	**1**	**2**	**3**	**4**	**5**		50
51	In med micro formulating concepts is more important than memorizing.	**1**	**2**	**3**	**4**	**5**		51
52	I understood how definitions in med micro should be applied to understand certain processes/concepts.	**1**	**2**	**3**	**4**	**5**		52
53	I pushed through with med micro although I found it boring.	**1**	**2**	**3**	**4**	**5**		53
54	Med micro was more difficult than the other 2nd-year modules.	**1**	**2**	**3**	**4**	**5**		54
55	When I encountered problems in med micro to understand the work, I started over with the basics.	**1**	**2**	**3**	**4**	**5**		55
56	When I prepared for med micro tests/exams, I worked through old test-/exam papers.	**1**	**2**	**3**	**4**	**5**		56
57	I discussed concepts, terms and aspects of med micro that I didn't understand with fellow students.	**1**	**2**	**3**	**4**	**5**		57
58	Personal problems were the reason why I couldn't do my best in med micro.	**1**	**2**	**3**	**4**	**5**		58
59	I participated in discussions in the med micro sessions.	**1**	**2**	**3**	**4**	**5**		59
60	I read too slow, therefore I was not able to finish in time with med micro tests/exams.	**1**	**2**	**3**	**4**	**5**		60

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

								For office use	
61	I made sure that I knew how much time I needed to prepare properly for a med micro test/exam.	**1**	**2**	**3**	**4**	**5**			61
62	I knew which sections of med micro were my weak areas.	**1**	**2**	**3**	**4**	**5**			62
63	I tried to find patterns by means of which I could memorize the work in med micro.	**1**	**2**	**3**	**4**	**5**			63
64	I became trapped/entangled in less important detail when I studied med micro and couldn't see the bigger picture.	**1**	**2**	**3**	**4**	**5**			64
65	I would have done better in med micro if I could study all the work on my own without attending lectures.	**1**	**2**	**3**	**4**	**5**			65
66	I will be able to keep up to date with important developments in med micro throughout my career as a doctor.	**1**	**2**	**3**	**4**	**5**			66
67	As a result of med micro being a lot of work, I didn't do as well in my other modules as I wanted to.	**1**	**2**	**3**	**4**	**5**			67
68	I find it difficult to understand the importance of med micro in the medical curriculum.	**1**	**2**	**3**	**4**	**5**			68
69	I can see myself as an independent lifelong learner in med micro.	**1**	**2**	**3**	**4**	**5**			69
70	I realize that the well-being of my patients could one day be greatly influenced by my knowledge of med micro.	**1**	**2**	**3**	**4**	**5**			70
71	I would like to become a specialist pathologist in med micro.	**1**	**2**	**3**	**4**	**5**			71
72	I studied med micro mainly to pass the module.	**1**	**2**	**3**	**4**	**5**			72
73	I think med micro would be more interesting/exciting to read and explore if I didn't have to learn it for tests and exams.	**1**	**2**	**3**	**4**	**5**			73
74	Med micro is suitable to learn in small group context.	**1**	**2**	**3**	**4**	**5**			74
75	I am looking forward to learn more about med micro and infectious diseases throughout the rest if my medical training.	**1**	**2**	**3**	**4**	**5**			75
76	Students who achieved good marks in med micro were probably more enthusiastic about the subject.	**1**	**2**	**3**	**4**	**5**			76
77	Med micro required a lot more discipline and effort from me than any of the other 2nd-year modules.	**1**	**2**	**3**	**4**	**5**			77
78	Developing into a lifelong learner in med micro depends on the marks obtained in the module.	**1**	**2**	**3**	**4**	**5**			78
79	The marks I obtained in med micro reflected my enthusiasm for and enjoyment of the subject.	**1**	**2**	**3**	**4**	**5**			79
80	Only students with exceptionally high intellectual abilities will be able to perform very well in med micro.	**1**	**2**	**3**	**4**	**5**			80

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

								For office use	
81	Academic achievement in med micro is more closely related to discipline and driving oneself than to intellectual ability.	**1**	**2**	**3**	**4**	**5**			81
82	Academic achievement in med micro is more closely related to enthusiasm for and enjoyment of the subject than to intellectual ability.	**1**	**2**	**3**	**4**	**5**			82
83	I was enthusiastic about med micro and therefore I obtained satisfactory marks.	**1**	**2**	**3**	**4**	**5**			83
84	I obtained good marks in med micro because I was trained since childhood to achieve only the very best I could.	**1**	**2**	**3**	**4**	**5**			84
85	The mark I obtained for med micro influenced my self-esteem.	**1**	**2**	**3**	**4**	**5**			85
86	I can become a good doctor as far as infectious diseases are concerned regardless of the mark I obtained for med micro.	**1**	**2**	**3**	**4**	**5**			86
87	My academic achievement in med micro influenced my relationship with my friends and family.	**1**	**2**	**3**	**4**	**5**			87
88	The mark I obtained in med micro made me doubt my career choice.	**1**	**2**	**3**	**4**	**5**			88
89	I had to cut down on pastime activities/hobbies and social interaction with friends/family in order to manage my med micro study obligations.	**1**	**2**	**3**	**4**	**5**			89
90	At some stage I believed/was afraid that I was going to fail the year as a result of med micro.	**1**	**2**	**3**	**4**	**5**			90
91	Learning med micro by means of "teaching" fellow students in a study group (or an imaginary group) helped me to master the subject contents.	**1**	**2**	**3**	**4**	**5**			91
92	I would like to teach med micro to medical/biomedical students.	**1**	**2**	**3**	**4**	**5**			92
93	When I told my friends/family about interesting things I have learned in med micro, they could see that I enjoyed the subject.	**1**	**2**	**3**	**4**	**5**			93
94	I realize that there is a possibility of making mistakes as a doctor if I don't have a thorough knowledge of med micro.	**1**	**2**	**3**	**4**	**5**			94
95	If I had to make a diagnosis of an infectious disease and decide on its treatment TODAY, I would feel confident to do so.	**1**	**2**	**3**	**4**	**5**			95

SECTION D PROCESSING OF INFORMATION/SUBJECT CONTENT

The purpose of this section is to obtain information with regard to different learning styles applied by students to master the subject content of medical microbiology/MJR 224: Infections (henceforth referred to as "med micro").

If the statement ***never/almost never*** applies to you, make a cross (X) over ***1.***
If the statement ***sometimes*** applies to you, make a X over ***2.***
If you are ***uncertain***, make a X over ***3.***
If the statement ***often (usually)*** applies to you, make a X over ***4.***
If the statement ***always/almost always*** applies to you, make a X over ***5.***

1 never/almost never	**2 sometimes**	**3 uncertain**	**4 often (usually)**	**5 always/almost always**

							For office use	
1	I would prefer to do a project in med micro rather than learn for tests and exams.	**1**	**2**	**3**	**4**	**5**		1
2	I prefer clear instructions from the lecturer before I start with a self-study/directed learning assignment.	**1**	**2**	**3**	**4**	**5**		2
3	I like to accumulate a lot of unique and creative ideas.	**1**	**2**	**3**	**4**	**5**		3
4	I memorize a lot of detail and facts when I study for a test/ exam.	**1**	**2**	**3**	**4**	**5**		4
5	I like to go over my assignments/study material more than once.	**1**	**2**	**3**	**4**	**5**		5
6	I like to take things apart to see how they work.	**1**	**2**	**3**	**4**	**5**		6
7	I prefer to know all the detail of the information that I'm busy with, regardless of the subject.	**1**	**2**	**3**	**4**	**5**		7
8	I prefer to come up with a totally different idea than the other members of the group when we have to perform a task.	**1**	**2**	**3**	**4**	**5**		8
9	I prefer to write a test if I have to prove how much I know about a topic/subject.	**1**	**2**	**3**	**4**	**5**		9
10	I like neat notes and a tidy desk and study area.	**1**	**2**	**3**	**4**	**5**		10
11	I like to work with instruments and apparatus.	**1**	**2**	**3**	**4**	**5**		11
12	I prefer to try out new ideas, although I know I might perhaps be discouraged.	**1**	**2**	**3**	**4**	**5**		12
13	It is important for me to understand all the guidelines and instructions before I will feel comfortable to do an assignment.	**1**	**2**	**3**	**4**	**5**		13
14	I like it most to learn through researching a topic.	**1**	**2**	**3**	**4**	**5**		14
15	I like tasks/assignments in which I am physically involved and where I have to use technical or mechanical apparatus.	**1**	**2**	**3**	**4**	**5**		15
16	I become frustrated when I have to wait for the lecturer to give the instructions before I can start with an assignment.	**1**	**2**	**3**	**4**	**5**		16
17	I prefer to investigate everything on my own without the assistance of the lecturer or fellow students.	**1**	**2**	**3**	**4**	**5**		17
18	I become frustrated when the guidelines/instructions for doing an assignment are changed after I have already started.	**1**	**2**	**3**	**4**	**5**		18

1 never/almost never	2 sometimes	3 uncertain	4 often (usually)	5 always/almost always

							For office use	
19	I like detailed notes when I have to prepare for tests and exams.	**1**	**2**	**3**	**4**	**5**		19
20	I don't like it to do assignments strictly according to instructions, especially when my own ideas are better.	**1**	**2**	**3**	**4**	**5**		20
21	I always tidy up my study area before I start working on an assignment/study for a test or exam.	**1**	**2**	**3**	**4**	**5**		21
22	I like the challenge to build or repair something.	**1**	**2**	**3**	**4**	**5**		22
23	I tend to start working quickly when given an assignment without thoroughly thinking about my answers.	**1**	**2**	**3**	**4**	**5**		23
24	I like to do research.	**1**	**2**	**3**	**4**	**5**		24
25	I like to present research results.	**1**	**2**	**3**	**4**	**5**		25
26	I ask more questions than most other students because I like to obtain knowledge.	**1**	**2**	**3**	**4**	**5**		26
27	I like to figure out how things work.	**1**	**2**	**3**	**4**	**5**		27
28	Other people, like my friends, say I'm very organized.							28
29	I like to figure out my own way of doing things well.	**1**	**2**	**3**	**4**	**5**		29
30	I would prefer to compile a portfolio containing different med micro assignments rather than write tests and exams.	**1**	**2**	**3**	**4**	**5**		30
31	I ask more questions than other students because I find it hard to understand new concepts quickly.	**1**	**2**	**3**	**4**	**5**		31
32	I listen to classical music while I study for a test/exam.	**1**	**2**	**3**	**4**	**5**		32
33	I ask a lot of questions because I don't feel confident about my own interpretation of new information.	**1**	**2**	**3**	**4**	**5**		33
34	When I have to start learning new study material, I am afraid that I will not be able to manage all the facts.	**1**	**2**	**3**	**4**	**5**		34
35	I listen to contemporary music when I study for a test/exam.	**1**	**2**	**3**	**4**	**5**		35
36	When preparing for a test/exam, I prefer to study completely on my own and do not discuss what I have learned with fellow students.	**1**	**2**	**3**	**4**	**5**		36
37	It has to be completely quiet when I study.	**1**	**2**	**3**	**4**	**5**		37
38	When I study for a test/exam, I can carry on for hours without taking a break.	**1**	**2**	**3**	**4**	**5**		38
39	I learn best when I study with a friend or in a small study group so that we can discuss problems along the way.	**1**	**2**	**3**	**4**	**5**		39
40	I don't like it when fellow students ask about the marks I obtained for tests/exams, even when I did well.	**1**	**2**	**3**	**4**	**5**		40
41	When I study for a test/exam, I prefer to take a break every 20–30 minutes.	**1**	**2**	**3**	**4**	**5**		41

☺ ☺ ***Thank you for your kind co-operation!!*** ☺ ☺

UNIVERSITEIT VAN DIE VRYSTAAT
FAKULTEIT GESONDHEIDSWETENSKAPPE
DEPARTEMENT MEDIESE MIKROBIOLOGIE
AFDELING ONDERWYSONTWIKKELING

VRAELYS I

VRAELYS AAN M.B.,Ch.B. III STUDENTE IN DIE FAKULTEIT GESONDHEIDSWETENSKAPPE, UNIVERSITEIT VAN DIE VRYSTAAT, BLOEMFONTEIN, TEN OPSIGTE VAN (a) LEERSTRATEGIEË EN DIE PROSESSERING VAN INLIGTING/VAKINHOUD, EN (b) PERSEPSIES VAN EN HOUDINGS TEENOOR DIE VAK MEDIESE MIKROBIOLOGIE (MODULE MJR 224: INFEKSIES)

Hierdie vraelys bestaan uit vier afdelings, naamlik:

(i) AFDELING A: Algemene en biografiese inligting
(ii) AFDELING B: Selfregulerende leerstrategieë
(iii) AFDELING C: Persepsies van en houdings teenoor die vak mediese mikrobiologie
(iv) AFDELING D: Prosessering van inligting/vakinhoud

ALGEMENE INLIGTING VIR VOLTOOIING VAN DIE VRAELYS

1. Hierdie vraelys bestaan uit 11 bladsye. Die voltooiing daarvan behoort nie meer as 30–40 minute van u tyd in beslag te neem nie.

2. U respons sal gebruik word vir navorsing in die veld van Gesondheidsberoepeonderwys (GBO), met spesifieke verwysing na studente se persepsies van en houdings teenoor mediese mikrobiologie as 'n basiese, pre-kliniese, biomediese wetenskap en leerstrategieë soos toegepas deur studente om die vakinhoud te prosesseer en bemeester.

3. Die vraelys word anoniem voltooi en die inhoud daarvan word as streng vertroulik beskou. Die inligting wat met behulp van hierdie vraelys bekom word, is die intellektuele eiendom van die Universiteit van die Vrystaat en sal in 'n navorsingsprojek wat deur die navorser onderneem word ten einde die graad Ph. D. (Gesondheidsberoepe-onderwys) te behaal, aangewend word.

4. Hierdie vraelys is NIE 'n evaluering van uself as student nie en op grond van die anonimiteit daarvan, kan u akademiese prestasie in MJR 224 (Infeksies) nie in berekening gebring word in die verwerking van die data wat verkry word nie.

5. Sinvolle gebruik van inligting wat met behulp van hierdie vraelys bekom word, is afhanklik van u korrekte, **eerlike** en deeglike voltooiing daarvan.

Dankie vir u samewerking. ***WEES ASSEBLIEF VERSEKER DAT DIT OPREG WAARDEER WORD.***

_____

M. C. STRUWIG

[**NOTA:** Hierdie vraelys is met toestemming aangepas uit Du Toit E. R. (1999). *'n Uitkomsgerigte model vir biologieonderwys met die fokus op selfregulerende leer.* Ph. D.-proefskrif. Bloemfontein: Universiteit van die Vrystaat.]

AFDELING A ALGEMENE EN BIOGRAFIESE INLIGTING ***KANTOORGEBRUIK***

☐☐☐ 1-3

Merk die nommer (X) ooreenstemmend met die stelling soos op u van toepassing.

Voorbeeld:

Ek geniet dit om 'n rugbywedstryd by te woon.	**1**
Ek geniet dit om 'n simfoniekonsert by te woon.	**2**

1. Geslag

Manlik	**1**
Vroulik	**2**

☐ 4

2. Huistaal

Afrikaans	**1**
Engels	**2**
Noord-Sotho	**3**
Suid-Sotho	**4**
Tswana	**5**
Xhosa	**6**
Zoeloe	**7**
Ander (indien **ander**, spesifiseer asseblief hieronder)	**8**

☐ 5

Ander taal: _____

3. Het u die tweedejaar herhaal?

Ja	**1**
Nee	**2**

☐ 6

4. Watter klas het u bygewoon?

Afrikaans	**1**
Engels	**2**

☐ 7

5. Het u 'n na-skoolse kwalifikasie? (bv. B.A., B.Sc.)

Ja (indien **ja**, spesifiseer asseblief hieronder)	**1**
Nee	**2**

☐ 8

Na-skoolse kwalifikasie(s): _____ ☐☐ 9-10

6. Waar woon u terwyl u studeer?

In 'n koshuis op die kampus	**1**
Alleen in 'n woonstel/meenthuis/huis	**2**
Deel 'n woonstel/meenthuis/huis met ander studente	**3**
By my ouers/ander familie	**4**
Ander (indien **ander**, spesifiseer asseblief hieronder)	**5**

☐ 11

Ander woonplek: _____

7. Sou u die atmosfeer in u woonplek as bevorderlik vir leer bestempel?

Ja	**1**
Nee (indien **nee**, voltooi asseblief **item 8**)	**2**

☐ 12

KANTOORGEBRUIK

8. Merk <u>AL die redes</u> wat van toepassing is op die omstandighede wat u beskou as NIE bevorderlik vir leer in u woonplek nie.

Ek sukkel om aan te pas vandat ek uit die huis is.	**1**	☐ 13
My huis-/woonstelmaat(s) hou my uit die werk uit.	**2**	☐ 14
Ek kom nie met my huis-/woonstelmaat(s) oor die weg nie.	**3**	☐ 15
My huis-/woonstelmaat(s) hou te veel partytjies.	**4**	☐ 16
My huis-/woonstelmaat(s) luister harde musiek terwyl ek wil leer.	**5**	☐ 17
Die standaard van my blyplek is nie dieselfde as dít waaraan ek gewoond was by die huis nie.	**6**	☐ 18
Ek is bekommerd oor die finansiële druk wat ek a.g.v. my blyplek ervaar.	**7**	☐ 19
Ander (indien **ander**, spesifiseer asseblief hieronder)	**8**	☐ 20

Ander redes waarom my woonplek nie bevorderlik is vir leer nie:

_____

_____

9. Is u'n lid van 'n aktiewe studiegroep?

Ja	**1**	☐ 21
Nee	**2**	

10. Beoefen u enige vryetyd aktiwiteite/stokperdjies?

Ja (indien **ja**, voltooi asseblief **item 11**)	**1**	☐ 22
Nee	**2**	

11. Kies u <u>VYF</u> mees gunsteling vryetyd aktiwiteite/stokperdjies uit die lys wat hieronder verskaf word.

Lees	**1**	☐☐ 23-24
Skryf (bv. kortverhale, gedigte)	**2**	☐☐ 25-26
Televisie kyk	**3**	☐☐ 27-28
Sport (as 'n **toeskouer**)	**4**	☐☐ 29-30
Sport (as 'n **deelnemer**)	**5**	☐☐ 31-32
Kuns (bv. skilder, beeldhouwerk, pottebakkery, houtsneewerk, uitstallings bywoon)	**6**	
Klassieke musiek (as 'n **luisteraar**)	**7**	
Klassieke musiek (as 'n **solo-/orkesdeelnemer**)	**8**	
Kontemporêre musiek (as 'n **luisteraar**)	**9**	
Kontemporêre musiek [as 'n **solo-/orkes- ("band") deelnemer**]	**10**	
Kuier rond saam met vriende	**11**	
Vrywillige werk vir liefdadigheidsorganisasies	**12**	
Kerklike/religieuse aktiwiteite	**13**	
Internet "surfing"	**14**	
Houtwerk	**15**	
Naaldwerk	**16**	
Fliek	**17**	
Ander (indien **ander**, spesifiseer asseblief hieronder)	**18**	

Ander vryetyd aktiwiteite/stokperdjies nie in die lys nie: ☐☐ 33-34

_____ ☐☐ 35-36

_____ ☐☐ 37-38

_____

AFDELING B SELFREGULERENDE LEERSTRATEGIEË

Die doel van die volgende items is om ondersoek in te stel na die verskillende aspekte van selfregulerende leerstrategieë soos toegepas deur die student in mediese mikrobiologie (verkort as "med mikro" word hierná gebruik).

As die stelling ***nooit/byna nooit*** op u van toepassing is ***nie***, maak 'n kruisie (X) oor ***1.***
As die stelling ***soms*** op u van toepassing is, maak 'n X oor ***2.***
As u ***onseker*** is, maak 'n X oor ***3.***
As die stelling ***dikwels (gewoonlik)*** op u van toepassing is, maak 'n X oor ***4.***
As die stelling ***altyd/byna altyd*** op u van toepassing is, maak 'n X oor ***5.***

1 nooit/byna nooit	**2 soms**	**3 onseker**	**4 dikwels (gewoonlik)**	**5 altyd/byna altyd**

							Kantoor-gebruik	
1	As ek vir 'n toets geleer het, het ek die inligting wat in die lesing/sessie verskaf is, sowel as my med mikro handboek gebruik.	**1**	**2**	**3**	**4**	**5**		1
2	As ek my opdragte/gerigte leer gedoen het, het ek probeer onthou wat die med mikro dosent(e) in die klas gesê het, want dit sou my help om my werk deeglik/korrek te doen.	**1**	**2**	**3**	**4**	**5**		2
3	Ek het myself gedurig vrae gevra om te bepaal of ek die med mikro materiaal wat ek besig was om te leer, ken.	**1**	**2**	**3**	**4**	**5**		3
4	Dit was moeilik om vir myself vas te stel wat die belangrikste aspekte van med mikro was wat ek moes ken.	**1**	**2**	**3**	**4**	**5**		4
5	As die med mikro studiemateriaal te moeilik was, het ek moed opgegee en net die makliker dele geleer.	**1**	**2**	**3**	**4**	**5**		5
6	As ek med mikro geleer het, het ek probeer om die moeiliker dele met my eie woorde te vervang.	**1**	**2**	**3**	**4**	**5**		6
7	Ek het altyd probeer verstaan wat die med mikro dosent(e) gesê het, selfs al het dit nie regtig sin gemaak nie.	**1**	**2**	**3**	**4**	**5**		7
8	As ek vir 'n med mikro toets geleer het, het ek probeer om soveel as moontlik feite te onthou.	**1**	**2**	**3**	**4**	**5**		8
9	As ek med mikro geleer het, het ek my notas/opsommings oor en oor neergeskryf om my te help onthou.	**1**	**2**	**3**	**4**	**5**		9
10	Ek het dikwels (gewoonlik) die vrae/oefeninge aan die einde van die hoofstukke in my med mikro handboek voltooi, al is dit nie van my verwag nie.	**1**	**2**	**3**	**4**	**5**		10
11	Selfs al was die med mikro studiemateriaal nie interessant nie, het ek gewerk totdat my opdragte voltooi is.	**1**	**2**	**3**	**4**	**5**		11
12	As ek vir 'n med mikro toets geleer het, het ek die feite oor en oor vir myself herhaal.	**1**	**2**	**3**	**4**	**5**		12
13	Ek het aan alles gedink wat ek sou nodig kry (bv. penne, kleurpotlode, opsommings) voordat ek med mikro begin leer het.	**1**	**2**	**3**	**4**	**5**		13
14	Ek het inligting uit vorige opdragte sowel as die handboek gebruik om nuwe opdragte in med mikro te doen.	**1**	**2**	**3**	**4**	**5**		14
15	Ek het dikwels (gewoonlik) feite/definisies in med mikro gelees sonder dat ek dit regtig verstaan het.	**1**	**2**	**3**	**4**	**5**		15

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

								Kantoor-gebruik	
16	My aandag het dikwels (gewoonlik) afgedwaal as die med mikro dosent 'n sessie aangebied het.	**1**	**2**	**3**	**4**	**5**			16
17	As ek 'n spesifieke onderwerp in med mikro geleer het, het ek probeer om al die aspekte bymekaar te pas.	**1**	**2**	**3**	**4**	**5**			17
18	As ek med mikro geleer het, het ek dikwels (gewoonlik) gestop om weer oor die werk te gaan waarmee ek reeds klaar was.	**1**	**2**	**3**	**4**	**5**			18
19	As ek vir 'n med mikro toets/eksamen voorberei het, het ek die woorde oor en oor gesê om my te help onthou.	**1**	**2**	**3**	**4**	**5**			19
20	Ek het 'n skema/diagram/tabel van die onderwerpe in elke med mikro sessie opgestel om my te help onthou.	**1**	**2**	**3**	**4**	**5**			20
21	Ek het hard gewerk om goeie punte in med mikro te behaal, al het ek nie die klasse geniet nie.	**1**	**2**	**3**	**4**	**5**			21
22	As ek med mikro studiemateriaal gelees het, het ek probeer om nuwe inligting in verband te bring met werk wat ek reeds geken het.	**1**	**2**	**3**	**4**	**5**			22
23	Ek het 2 weke voor die tyd begin leer vir med mikro toetse.	**1**	**2**	**3**	**4**	**5**			23
24	Ek het die biblioteek en ander bronne (bv. die internet) gebruik om meer kennis in med mikro te bekom.	**1**	**2**	**3**	**4**	**5**			24
25	Ek het 'n lys gemaak van terminologie wat ek nie geken/ verstaan het nie om dit later op te soek.	**1**	**2**	**3**	**4**	**5**			25
26	Ek het bykomend tot die studiemateriaal wat ek ontvang het, notas gemaak in die med mikro sessies.	**1**	**2**	**3**	**4**	**5**			26
27	Ek het myself van alles geïsoleer wat my konsentrasie kon verbreek as ek med mikro geleer het.	**1**	**2**	**3**	**4**	**5**			27
28	As ek my doel bereik het en goed gedoen het in 'n med mikro toets, het ek myself op 'n manier beloon (bv. 'n middag af, gaan fliek).	**1**	**2**	**3**	**4**	**5**			28
29	As ek probleme met med mikro ondervind het, het ek 'n dosent of mede-student vir hulp gevra.	**1**	**2**	**3**	**4**	**5**			29
30	Die ENIGSTE rede hoekom ek med mikro geleer het, was omdat dit 'n verpligte module is wat ek moes slaag.	**1**	**2**	**3**	**4**	**5**			30
31	As ek probleme met med mikro ondervind het, het ek probeer om 'n oplossing te vind om dit te hanteer.	**1**	**2**	**3**	**4**	**5**			31
32	Ek sou verkies het om med mikro op 'n meer ontspanne, informele manier te leer.	**1**	**2**	**3**	**4**	**5**			32
33	Entoesiasme en intrinsieke motivering is belangriker vir ontwikkeling in 'n lewenslange leerder in med mikro as intellektuele vermoë of akademiese prestasie.	**1**	**2**	**3**	**4**	**5**			33
34	Ek het skuldig gevoel as ek tyd afgevat het om iets saam met my vriende te doen in plaas daarvan om med mikro te leer.	**1**	**2**	**3**	**4**	**5**			34
35	Ek het op my eie meer van med mikro geleer as in kleingroep besprekings tydens formele sessies.	**1**	**2**	**3**	**4**	**5**			35
36	Ek het med mikro geleer deur "klas te gee" vir mede-studente of denkbeeldige studente.	**1**	**2**	**3**	**4**	**5**			36

AFDELING C PERSEPSIES VAN EN HOUDINGS TEENOOR DIE VAK MEDIESE MIKROBIOLOGIE (MODULE MJR 224: INFEKSIES)

Die doel van hierdie afdeling is om inligting te bekom ten opsigte van u persepsie van en houding teenoor mediese mikrobiologie/MJR 224: Infeksies (voortaan "med mikro") as 'n verpligte module in die voorgraadse mediese kurrikulum. Analise van hierdie response sal die navorser in staat stel om te bepaal of daar vanuit die studente se oogpunt enige hindernisse bestaan wat hulle kon verhoed om 'n bevredigende akademiese prestasie in die vak te behaal.

As die stelling ***nooit/byna nooit*** op u van toepassing is ***nie***, maak 'n kruisie (X) oor ***1.***
As die stelling ***soms*** op u van toepassing is, maak 'n X oor ***2.***
As u ***onseker*** is, maak 'n X oor ***3.***
As die stelling ***dikwels (gewoonlik)*** op u van toepassing is, maak 'n X oor ***4.***
As die stelling ***altyd/byna altyd*** op u van toepassing is, maak 'n X oor ***5.***

1 nooit/byna nooit	**2 soms**	**3 onseker**	**4 dikwels (gewoonlik)**	**5 altyd/byna altyd**

								Kantoor-gebruik	
1	Ek het med mikro as vak geniet.	**1**	**2**	**3**	**4**	**5**			1
2	Ek het angstig gevoel as ek 'n toets/eksamen in med mikro moes skryf.	**1**	**2**	**3**	**4**	**5**			2
3	As ek agter geraak het in med mikro, het ek ekstra moeite gedoen om die werk in te haal.	**1**	**2**	**3**	**4**	**5**			3
4	Ek het dít wat ek in med mikro geleer het, aan my vriende, ouers en ander persone verduidelik.	**1**	**2**	**3**	**4**	**5**			4
5	Die med mikro dosente het terminologie gebruik wat ek nie verstaan het nie en dit het my verwar.	**1**	**2**	**3**	**4**	**5**			5
6	Ek weet my vermoë in med mikro was goed.	**1**	**2**	**3**	**4**	**5**			6
7	As ek med mikro geleer het/opdragte gedoen het, het ek senuweeagtig geraak.	**1**	**2**	**3**	**4**	**5**			7
8	Ek het myself mondeling en/of m.b.v. skriftelike "toetse" geassesseer op die werk wat ek in med mikro geleer het.	**1**	**2**	**3**	**4**	**5**			8
9	Ek kan aan voorbeelde dink waar ek die kennis wat ek in med mikro bekom het, kan toepas.	**1**	**2**	**3**	**4**	**5**			9
10	Ek het van die plek (omgewing/studie-area) waar ek vir med mikro toetse geleer het, gehou.	**1**	**2**	**3**	**4**	**5**			10
11	As die med mikro lesing/sessie vervelig was, het ek belangstelling verloor en ander goed gedoen (bv. notas vir my vriende geskryf) om die tyd om te kry.	**1**	**2**	**3**	**4**	**5**			11
12	Ek kon myself nie baie goed uitdruk as ek skielik 'n vraag oor med mikro moes beantwoord nie.	**1**	**2**	**3**	**4**	**5**			12
13	Ek het my med mikro gerigte leer/selfstudie opdragte uitgestel om iets meer interessant te doen.	**1**	**2**	**3**	**4**	**5**			13
14	Ek het geweet wat om te doen as ek oplossings vir probleme moes kry of resultate in med mikro moes ontleed.	**1**	**2**	**3**	**4**	**5**			14
15	Ontevredenheid en/of frustrasie het my daarvan weerhou om so hard te werk in med mikro as wat ek moes.	**1**	**2**	**3**	**4**	**5**			15
16	Ek dink al die onderwerpe in med mikro was sinvol.	**1**	**2**	**3**	**4**	**5**			16

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

							Kantoor-gebruik	
17	Ek het punte verloor in med mikro toetse/eksamens omdat ek korrekte antwoorde doodgetrek het.	**1**	**2**	**3**	**4**	**5**		17
18	Ek het herhaaldelik 'n probleem/moeilike deel van die med mikro studiemateriaal deurgelees totdat ek dit verstaan het.	**1**	**2**	**3**	**4**	**5**		18
19	Ek het probeer om 'n verband/verwantskap tussen die verskillende afdelings van med mikro te vind.	**1**	**2**	**3**	**4**	**5**		19
20	Ek was te bang om vir die dosent(e) vrae oor med mikro te vra.	**1**	**2**	**3**	**4**	**5**		20
21	Dit was vir my belangriker om sekere begrippe te verstaan in med mikro as om net die inhoud te ken.	**1**	**2**	**3**	**4**	**5**		21
22	As ek nie saam met my vriende aan 'n gesprek oor sekere aspekte van med mikro kon deelneem nie, het ek angstig gevoel.	**1**	**2**	**3**	**4**	**5**		22
23	Ek het probeer om op datum te bly deur elke week die nuwe werk in med mikro deeglik te leer.	**1**	**2**	**3**	**4**	**5**		23
24	Ek het so hard as moontlik probeer om makliker oplossings te kry vir werk in med mikro wat ek nie verstaan het nie.	**1**	**2**	**3**	**4**	**5**		24
25	Ek het die dosent(e) vir hulp gevra met opdragte wat nie duidelik was nie.	**1**	**2**	**3**	**4**	**5**		25
26	Ek het probleme in med mikro opgelos deur die stappe van probleemoplossing* toe te pas.	**1**	**2**	**3**	**4**	**5**		26
27	As ons groepopdragte in med mikro moes doen, het ek deel-geneem en probeer om oplossings/antwoorde te kry.	**1**	**2**	**3**	**4**	**5**		27
28	Ek het altyd aandag gegee in die med mikro sessies.	**1**	**2**	**3**	**4**	**5**		28
29	Ek het baie senuweeagtig geraak as ek nie verstaan het wat die dosent verduidelik het nie.	**1**	**2**	**3**	**4**	**5**		29
30	Dit was vir my belangrik om die betekenis van begrippe/ terme in med mikro wat ek nie verstaan het nie, te vind.	**1**	**2**	**3**	**4**	**5**		30
31	Dit was vir my maklik om myself in 'n med mikro toets/ eksamen uit te druk.	**1**	**2**	**3**	**4**	**5**		31
32	Dit was iemand anders (bv. die dosente/my vriende) se skuld dat ek nie hard genoeg kon werk in med mikro nie.	**1**	**2**	**3**	**4**	**5**		32
33	Ek het punte verloor in med mikro toetse/eksamens omdat ek te stadig of te vinnig (oorhaastig) gewerk het.	**1**	**2**	**3**	**4**	**5**		33
34	Ek het my med mikro opdragte/gerigte leer uitgestel om iets anders te doen.	**1**	**2**	**3**	**4**	**5**		34
35	Ek probeer om in my daaglikse lewe dít wat ek in med mikro geleer het, toe te pas.	**1**	**2**	**3**	**4**	**5**		35
36	Ek het probleme met my visie/gehoor, maar ek het nie die vrymoedigheid gehad om na 'n ander sitplek te skuif nie.	**1**	**2**	**3**	**4**	**5**		36
37	Nadat ek 'n ruk lank geleer het, was dit vir my moeilik om op med mikro te konsentreer.	**1**	**2**	**3**	**4**	**5**		37

* Stappe van probleemoplossing: (1) lees die probleem deur en klaar onduidelike terme uit; (2) herformuleer die probleem in u eie woorde; (3) formuleer leerdoelwitte; (4) pas toepaslike leerstrategieë toe om doelwitte te bereik; (5) bepaal deur self-assessering of doelwitte bereik is.

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

							Kantoor-gebruik	
38	As ek med mikro (opdragte/leer) gedoen het, het ek lomerig, moeg of geïrriteerd geraak.	**1**	**2**	**3**	**4**	**5**		38
39	Ek het al die foute wat ek in med mikro toetse gemaak het, opgevolg.	**1**	**2**	**3**	**4**	**5**		39
40	Ek het swak gedoen in med mikro as gevolg van my huislike omstandighede.	**1**	**2**	**3**	**4**	**5**		40
41	Ek het 'n geheelbeeld van die werk wat ek moes leer, gevorm voordat ek begin leer het vir 'n med mikro toets.	**1**	**2**	**3**	**4**	**5**		41
42	Ek het entoesiasties gevoel oor med mikro.	**1**	**2**	**3**	**4**	**5**		42
43	Al het ek besef die med mikro module dek nie al die detail van die vakgebied nie, het ek geweet dít wat ek moes ken, was belangrik.	**1**	**2**	**3**	**4**	**5**		43
44	Ek het alle definisies en med mikro feite uit my kop geleer.	**1**	**2**	**3**	**4**	**5**		44
45	As ek die werk in med mikro nie verstaan het nie, het ek probeer om dit uit 'n ander hoek te benader totdat dit sin gemaak het.	**1**	**2**	**3**	**4**	**5**		45
46	Ek het sekere begrippe in med mikro nie verstaan nie.	**1**	**2**	**3**	**4**	**5**		46
47	Ek weet dit is belangrik dat ek my kennis van med mikro gebruik.	**1**	**2**	**3**	**4**	**5**		47
48	Ek het my diagramme/tabelle/opsommings helder en kleurvol gemaak sodat dit duideliker kon uitstaan.	**1**	**2**	**3**	**4**	**5**		48
49	Ek het soms in die middel van 'n paragraaf opgehou lees om seker te maak dat ek verstaan wat ek gelees het.	**1**	**2**	**3**	**4**	**5**		49
50	Ek was onseker of my med mikro opdragte/gerigte leer korrek was, maar ek het gehuiwer om die dosent te vra.	**1**	**2**	**3**	**4**	**5**		50
51	In med mikro is die formulering van begrippe belangriker as memorisering.	**1**	**2**	**3**	**4**	**5**		51
52	Ek het verstaan hoe definisies in med mikro toegepas moet word om sekere prosesse/begrippe te kon verstaan.	**1**	**2**	**3**	**4**	**5**		52
53	Ek het deurgedruk met med mikro al was dit vir my vervelig.	**1**	**2**	**3**	**4**	**5**		53
54	Med mikro was moeiliker as die ander 2de-jaar modules.	**1**	**2**	**3**	**4**	**5**		54
55	As ek probleme ondervind het om die werk in med mikro te verstaan, het ek weer voor begin met die *"basics"*.	**1**	**2**	**3**	**4**	**5**		55
56	As ek vir med mikro toetse/eksamens voorberei het, het ek ou vraestelle deurgewerk.	**1**	**2**	**3**	**4**	**5**		56
57	Ek het begrippe, terme en aspekte van med mikro wat ek nie verstaan het nie, met mede-studente bespreek.	**1**	**2**	**3**	**4**	**5**		57
58	Persoonlike probleme was die rede waarom ek nie my bes kon doen in med mikro nie.	**1**	**2**	**3**	**4**	**5**		58
59	Ek het in die med mikro sessies aan die besprekings deelgeneem.	**1**	**2**	**3**	**4**	**5**		59
60	Ek lees te stadig, daarom kon ek nie klaarkry met med mikro toetse/eksamens nie.	**1**	**2**	**3**	**4**	**5**		60

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

								Kantoor-gebruik	
61	Ek het seker gemaak dat ek weet hoeveel tyd ek nodig het om deeglik vir 'n med mikro toets/eksamen voor te berei.	**1**	**2**	**3**	**4**	**5**			61
62	Ek het geweet watter afdelings van med mikro was my swak areas.	**1**	**2**	**3**	**4**	**5**			62
63	Ek het probeer om patrone te vind waarvolgens ek die werk in med mikro kon memoriseer.	**1**	**2**	**3**	**4**	**5**			63
64	Ek het verstrik geraak in minder belangrike detail as ek med mikro geleer het en kon nie die groter geheel raaksien nie.	**1**	**2**	**3**	**4**	**5**			64
65	Ek sou beter gedoen het in med mikro as ek al die werk op my eie kon leer sonder om lesings by te woon.	**1**	**2**	**3**	**4**	**5**			65
66	Dit sal vir my moontlik wees om dwarsdeur my loopbaan as dokter op datum te bly met nuwe ontwikkelinge in med mikro.	**1**	**2**	**3**	**4**	**5**			66
67	As gevolg van die feit dat med mikro baie werk was, het ek nie in die ander modules so goed gedoen as wat ek wou nie.	**1**	**2**	**3**	**4**	**5**			67
68	Ek vind dit moeilik om die belang van med mikro in die mediese kurrikulum te verstaan.	**1**	**2**	**3**	**4**	**5**			68
69	Ek kan myself as 'n onafhanklike, lewenslange leerder in med mikro sien.	**1**	**2**	**3**	**4**	**5**			69
70	Ek besef dat die welstand van my pasiënte eendag ernstig beïnvloed kan word deur my kennis van med mikro.	**1**	**2**	**3**	**4**	**5**			70
71	Ek sal graag 'n spesialis patoloog in med mikro wil word.	**1**	**2**	**3**	**4**	**5**			71
72	Ek het med mikro geleer hoofsaaklik net om die module te slaag.	**1**	**2**	**3**	**4**	**5**			72
73	Ek dink med mikro sou interessanter/meer opwindend gewees het om te lees en te ontdek as dit nie nodig was dat ek moes leer vir toetse en eksamens nie.	**1**	**2**	**3**	**4**	**5**			73
74	Med mikro is geskik om in kleingroep konteks te leer.	**1**	**2**	**3**	**4**	**5**			74
75	Ek sien uit daarna om meer van med mikro en infektiewe siektes te leer dwarsdeur die res van my mediese opleiding.	**1**	**2**	**3**	**4**	**5**			75
76	Studente wat goeie punte in med mikro behaal het, was waarskynlik meer entoesiasties oor die vak.	**1**	**2**	**3**	**4**	**5**			76
77	Med mikro het baie meer dissipline en moeite *("effort")* van my geverg as enige van die ander 2de-jaar modules.	**1**	**2**	**3**	**4**	**5**			77
78	Om 'n lewenslange leerder in med mikro te word, hang af van die punte behaal in die module.	**1**	**2**	**3**	**4**	**5**			78
79	Die punte wat ek in med mikro behaal het, het my entoesiasme daarvoor en genieting van die vak weerspieël.	**1**	**2**	**3**	**4**	**5**			79
80	Net studente met uitsonderlike hoë intellektuele vermoëns sal in staat wees om baie goed te doen in med mikro.	**1**	**2**	**3**	**4**	**5**			80

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

								Kantoor-gebruik	
81	Akadmiese prestasie in med mikro hou meer verband met dissipline en selfdrywing *("driving oneself")* as met intellektuele vermoë.	**1**	**2**	**3**	**4**	**5**			81
82	Akademiese prestasie in med mikro hou meer verband met entoesiasme vir en genieting van die vak as met intellektuele vermoë.	**1**	**2**	**3**	**4**	**5**			82
83	Ek was entoesiasties oor med mikro en daarom het ek bevredigende punte behaal.	**1**	**2**	**3**	**4**	**5**			83
84	Ek het goeie punte in med mikro behaal, omdat ek van kleins af geleer is om net my heel beste te gee.	**1**	**2**	**3**	**4**	**5**			84
85	Die punt wat ek vir med mikro behaal het, het my selfbeeld/ eie-waarde beïnvloed.	**1**	**2**	**3**	**4**	**5**			85
86	Ek kan 'n goeie dokter word sover dit infektiewe siektes aangaan, ongeag die punt wat ek vir med mikro behaal het.	**1**	**2**	**3**	**4**	**5**			86
87	My akademiese prestasie in med mikro het my verhoudings met my vriende en familie beïnvloed.	**1**	**2**	**3**	**4**	**5**			87
88	Die punt wat ek vir med mikro gekry het, het my aan my loopbaankeuse laat twyfel.	**1**	**2**	**3**	**4**	**5**			88
89	Ek moes afskaal op vryetyd aktiwiteite/stokperdjies en sosiale interaksie met vriende/familie ten einde my med mikro studieverpligtinge te kon nakom.	**1**	**2**	**3**	**4**	**5**			89
90	Op 'n stadium het ek geglo/was ek bang dat ek die jaar sou druip a.g.v. med mikro.	**1**	**2**	**3**	**4**	**5**			90
91	Dit het my gehelp om die vakinhoud te bemeester deurdat ek med mikro geleer het terwyl ek vir mede-studente in 'n studiegroep (of 'n denkbeeldige groep) "klasgegee" het.	**1**	**2**	**3**	**4**	**5**			91
92	Ek sal daarvan hou om in med mikro vir mediese/ biomediese studente klas te gee.	**1**	**2**	**3**	**4**	**5**			92
93	As ek vir my vriende/familie interessante goed wat ek in med mikro geleer het, vertel het, kon hulle sien dat ek die vak geniet het.	**1**	**2**	**3**	**4**	**5**			93
94	Ek besef dat daar 'n moontlikheid bestaan om foute te maak as 'n dokter as ek nie deeglike kennis van med mikro het nie.	**1**	**2**	**3**	**4**	**5**			94
95	As ek VANDAG 'n diagnose van 'n infektiewe siekte moet maak en moet besluit op die behandeling daarvan, sal ek die selfvertroue hê om dit te doen.	**1**	**2**	**3**	**4**	**5**			95

AFDELING D PROSESSERING VAN INLIGTING/VAKINHOUD

Die doel van hierdie afdeling is om inligting te bekom t.o.v. die verskillende leerstyle soos toegepas deur studente om die vakinhoud van mediese mikrobiologie/MJR 224: Infeksies (voortaan "med mikro") te bemeester.

As die stelling ***nooit/byna nooit*** op u van toepassing is ***nie***, maak 'n kruisie (X) oor ***1.***
As die stelling ***soms*** op u van toepassing is, maak 'n X oor ***2.***
As u ***onseker*** is, maak 'n X oor ***3.***
As die stelling ***dikwels (gewoonlik)*** op u van toepassing is, maak 'n X oor ***4.***
As die stelling ***altyd/byna altyd*** op u van toepassing is, maak 'n X oor ***5.***

1 nooit/byna nooit	**2 soms**	**3 onseker**	**4 dikwels (gewoonlik)**	**5 altyd/byna altyd**

								Kantoor-gebruik	
1	Ek sou verkies het om 'n projek in med mikro te doen eerder as om te leer vir toetse en eksamens.	**1**	**2**	**3**	**4**	**5**			1
2	Ek verkies duidelike instruksies van die dosent voordat ek begin met 'n selfstudie/gerigte leer opdrag.	**1**	**2**	**3**	**4**	**5**			2
3	Ek hou daarvan om 'n klomp unieke en kreatiewe idees te versamel.	**1**	**2**	**3**	**4**	**5**			3
4	Ek memoriseer baie detail en feite wanneer ek vir 'n toets/eksamen leer.	**1**	**2**	**3**	**4**	**5**			4
5	Ek hou daarvan om meer as een keer my opdragte/studie-materiaal oor te gaan.	**1**	**2**	**3**	**4**	**5**			5
6	Ek hou daarvan om goed uitmekaar te haal om te sien hoe dit werk.	**1**	**2**	**3**	**4**	**5**			6
7	Ek verkies om al die detail van die inligting waarmee ek besig is, te ken, ongeag die vak/onderwerp.	**1**	**2**	**3**	**4**	**5**			7
8	As ons 'n taak moet uitvoer, verkies ek om met 'n idee wat totaal anders is as dié van die ander lede van die groep, vorendag te kom.	**1**	**2**	**3**	**4**	**5**			8
9	Ek verkies om 'n toets te skryf as ek moet bewys hoeveel ek van 'n onderwerp/vak weet.	**1**	**2**	**3**	**4**	**5**			9
10	Ek hou van netjiese notas, lessenaar en studie-area.	**1**	**2**	**3**	**4**	**5**			10
11	Ek hou daarvan om met instrumente en apparaat te werk.	**1**	**2**	**3**	**4**	**5**			11
12	Ek verkies om nuwe idees uit te probeer, al weet ek ek kan moontlik ontmoedig word.	**1**	**2**	**3**	**4**	**5**			12
13	Dit is vir my belangrik om al die riglyne en instruksies te verstaan voordat ek op my gemak voel om 'n opdrag te doen.	**1**	**2**	**3**	**4**	**5**			13
14	Ek hou die meeste daarvan om te leer deur navorsing oor 'n onderwerp te doen.	**1**	**2**	**3**	**4**	**5**			14
15	Ek hou van take/opdragte waarby ek fisies betrokke is en waar ek tegniese of meganiese apparaat moet gebruik.	**1**	**2**	**3**	**4**	**5**			15
16	Ek raak gefrustreerd as ek vir die dosent moet wag om die instruksies te gee voordat ek met 'n opdrag kan begin.	**1**	**2**	**3**	**4**	**5**			16
17	Ek verkies om alles op my eie te ondersoek sonder die hulp van die dosent of mede-studente.	**1**	**2**	**3**	**4**	**5**			17
18	Ek raak gefrustreerd as die riglyne/instruksies vir 'n opdrag verander word nadat ek reeds daarmee begin het.	**1**	**2**	**3**	**4**	**5**			18

1 nooit/byna nooit	2 soms	3 onseker	4 dikwels (gewoonlik)	5 altyd/byna altyd

							Kantoor-gebruik	
19	Ek hou van gedetailleerde notas as ek vir toetse en eksamens moet voorberei.	**1**	**2**	**3**	**4**	**5**		19
20	Ek hou nie daarvan om opdragte streng volgens instruksies te doen nie, veral as my eie idees beter is.	**1**	**2**	**3**	**4**	**5**		20
21	Ek maak altyd my studie-area netjies voordat ek aan 'n opdrag begin werk/begin leer vir 'n toets/eksamen.	**1**	**2**	**3**	**4**	**5**		21
22	Ek hou van die uitdaging om iets te bou of reg te maak.	**1**	**2**	**3**	**4**	**5**		22
23	Wanneer ek 'n opdrag kry, is ek geneig om haastig te begin werk sonder om eers oor my antwoorde te dink.	**1**	**2**	**3**	**4**	**5**		23
24	Ek hou daarvan om navorsing te doen.	**1**	**2**	**3**	**4**	**5**		24
25	Ek hou daarvan om navorsingsresultate voor te dra.	**1**	**2**	**3**	**4**	**5**		25
26	Ek vra meer vrae as ander studente, want ek hou daarvan om kennis te bekom.	**1**	**2**	**3**	**4**	**5**		26
27	Ek hou daarvan om uit te vind hoe goed werk.	**1**	**2**	**3**	**4**	**5**		27
28	Ander mense, soos my vriende, sê ek is baie georganiseerd.	**1**	**2**	**3**	**4**	**5**		28
29	Ek hou daarvan om op my eie manier uit te vind om dinge goed te doen.	**1**	**2**	**3**	**4**	**5**		29
30	Ek sou dit verkies het om 'n portefeulje saam te stel met verskillende med mikro opdragte in plaas daarvan om toetse en eksamens te skryf.	**1**	**2**	**3**	**4**	**5**		30
31	Ek vra meer vrae as ander studente omdat dit vir my moeilik is om nuwe begrippe vinnig te verstaan.	**1**	**2**	**3**	**4**	**5**		31
32	Ek luister na klassieke musiek terwyl ek vir 'n toets/eksamen leer.	**1**	**2**	**3**	**4**	**5**		32
33	Ek vrae baie vrae, want ek het nie veel vertroue in my eie interpretasie van nuwe inligting nie.	**1**	**2**	**3**	**4**	**5**		33
34	As ek nuwe studiemateriaal begin leer, is ek bang dat ek nie al die feite sal kan baasraak nie.	**1**	**2**	**3**	**4**	**5**		34
35	Ek luister na kontemporêre musiek terwyl ek vir 'n toets/eksamen leer.	**1**	**2**	**3**	**4**	**5**		35
36	As ek vir 'n toets/eksamen voorberei, verkies ek om heeltemal op my eie te leer en nie dít wat ek geleer het, met mede-studente te bespreek nie.	**1**	**2**	**3**	**4**	**5**		36
37	Dit moet geheel en al stil wees wanneer ek leer.	**1**	**2**	**3**	**4**	**5**		37
38	As ek vir 'n toets/eksamen leer, kan ek vir ure aangaan sonder om 'n ruspouse *("break")* te vat.	**1**	**2**	**3**	**4**	**5**		38
39	Ek leer op my beste saam met 'n vriend of in 'n klein studie-groep sodat ons probleme kan bespreek wat ons teëkom.	**1**	**2**	**3**	**4**	**5**		39
40	Ek hou nie daarvan as mede-studente my uitvra oor die punte wat ek vir toetse/eksamens behaal het nie, selfs al het ek goed gedoen.	**1**	**2**	**3**	**4**	**5**		40
41	As ek vir 'n toets/eksamen leer, verkies ek om elke 20–30 minute 'n ruspouse *("break")* te vat.	**1**	**2**	**3**	**4**	**5**		41

☺ ☺ Dankie vir u vriendelike samewerking!! ☺ ☺

APPENDIX B

UNIVERSITY OF THE FREE STATE
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF MEDICAL MICROBIOLOGY
DIVISION FOR EDUCATIONAL DEVELOPMENT

QUESTIONNAIRE II

QUESTIONNAIRE TO M.B.,Ch.B. III STUDENTS IN THE FACULTY OF HEALTH SCIENCES, UNIVERSITY OF THE FREE STATE, BLOEMFONTEIN, WITH REGARD TO THE EVALUATION OF THE BOARD GAME* MED MICRO FUN WITH FACTS *(MMFWF) AS A SUPPLEMENTARY LEARNING METHOD IN THE SUBJECT MEDICAL MICROBIOLOGY

GENERAL INFORMATION FOR COMPLETION OF THE QUSTIONNAIRE

1. **THANK YOU FOR YOUR PARTICIPATION IN THE INTRODUCTORY PHASE OF THE MED MICRO FUN WITH FACTS BOARD GAME.**

2. This questionnaire contains 62 items and consists of four and a half (4½) pages. Its completion should not require more than 30 minutes of your time.

3. The purpose of this questionnaire is to evaluate by means of your feedback, the MED MICRO FUN WITH FACTS board game as a potential, supplementary learning method in medical microbiology.

4. Your response and recommendations will also be used to finalize and, if necessary, to adjust the game for future use by undergraduate medical students.

5. The questionnaire is completed anonymously and its content is strictly confidential. In order to link the two questionnaires, **YOU ARE REQUESTED TO USE THE SAME NUMBER ON THIS QUESTIONNAIRE (p. 2, TOP RIGHT, SQUARES 1–3) AS THE NUMBER ALLOCATED TO YOU FOR QUESTIONNAIRE I.**

6. The information obtained by means of this questionnaire is the intellectual property of the University of the Free State and will be applied in a research project undertaken by the researcher to obtain the degree Ph.D. (Health Professions Education).

7. Meaningful application of information obtained by means of this questionnaire depends on your correct, **honest** and thorough completion thereof.

Thank you for your co-operation. Please be assured that this study would not have been possible without your feedback and input. It is sincerely appreciated.

_____

M. C. STRUWIG

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EVALUATION OF MMFWF AS A SUPPLEMENTARY LEARNING METHOD IN MEDICAL MICROBIOLOGY

Read through each of the following items and mark by means of a cross (X) on a scale of 1 – 5 to what extent the statement reflects your perceptions of the Med Micro Fun with facts board game (henceforth abbreviated as "MMFWF"), as indicated below:

- if the statement does ***not at all*** reflect/represent your perception of MMFWF, mark ***1;***
- if the statement ***to a small degree*** reflects/represents your perception of MMFWF, mark ***2;***
- if you are ***uncertain,*** mark ***3;***
- if the statement ***to a fair degree*** reflects/represents your perception of MMFWF, mark ***4;***
- if the statement ***completely*** reflects/represents you perception of MMFWF, ***5.***

PLEASE NOTE: YOU ARE KINDLY REQUESTED TO MAKE A DEFINITIVE CHOICE AS FAR AS POSSIBLE AND CHOOSE *OPTION 3* ONLY IF YOU ARE REALLY UNCERTAIN AND NOT CONVINCED THAT THE STATEMENT IS REPRESENTATIVE OR NOT OF YOUR PERCEPTION OF THE BOARD GAME.

1 not at all	2 to a small degree	3 uncertain	4 to a fair degree	5 completely

							Office use	
1	The content (questions and answers) of MMFWF was meaningful to me.	**1**	**2**	**3**	**4**	**5**		4
2	I obtained quite a lot of new knowledge by playing MMFWF.	**1**	**2**	**3**	**4**	**5**		5
3	I understood all the rules of MMFWF very well.	**1**	**2**	**3**	**4**	**5**		6
4	The exposure to MMFWF made me realize that I still have a lot to learn about medical microbiology.	**1**	**2**	**3**	**4**	**5**		7
5	I like board games in general.	**1**	**2**	**3**	**4**	**5**		8
6	I would prefer to play a CD-ROM version of MMFWF on my own.	**1**	**2**	**3**	**4**	**5**		9
7	It works well to play MMFWF in a team instead of individually.	**1**	**2**	**3**	**4**	**5**		10
8	MMFWF made me realize how little I remember of what I have learned in module MJR 224 (Infections).	**1**	**2**	**3**	**4**	**5**		11
9	There was active group interaction while we were playing MMFWF.	**1**	**2**	**3**	**4**	**5**		12
10	I feel more enthusiastic about medical microbiology since I have played MMFWF.	**1**	**2**	**3**	**4**	**5**		13
11	I felt uncomfortable when I couldn't answer a question immediately.	**1**	**2**	**3**	**4**	**5**		14
12	I was afraid my fellow-students would have a negative image of me if I gave an incorrect answer.	**1**	**2**	**3**	**4**	**5**		15
13	Students will be able to master the facts of medical microbiology in a relaxed, informal way by means of MMFWF.	**1**	**2**	**3**	**4**	**5**		16
14	I would prefer to play MMFWF on an individual basis instead of in a team.	**1**	**2**	**3**	**4**	**5**		17
15	I felt nervous/stressed out while I played MMFWF.	**1**	**2**	**3**	**4**	**5**		18
16	MMFWF will help students to improve their communication skills.	**1**	**2**	**3**	**4**	**5**		19
17	MMFWF will help students to present their knowledge of medical microbiology verbally.	**1**	**2**	**3**	**4**	**5**		20
18	Many of the questions resulted in spontaneous group discussions.	**1**	**2**	**3**	**4**	**5**		21

1 not at all	2 to a small degree	3 uncertain	4 to a fair degree	5 completely

Office use

19	The concept on which the development of MMFWF was based can be applied to other modules as well.	**1**	**2**	**3**	**4**	**5**		22
20	MMFWF can be a useful learning instrument for students in medical microbiology.	**1**	**2**	**3**	**4**	**5**		23
21	MMFWF creates an opportunity to exchange knowledge with fellow-students (colleagues).	**1**	**2**	**3**	**4**	**5**		24
22	I am by nature very competitive.	**1**	**2**	**3**	**4**	**5**		25
23	The visual aspect of MMFWF (photographs on the back of the cards) made the questions more clear to me.	**1**	**2**	**3**	**4**	**5**		26
24	MMFWF made me realize that medical microbiology is an extremely vast field of study.	**1**	**2**	**3**	**4**	**5**		27
25	MMFWF was boring to me.	**1**	**2**	**3**	**4**	**5**		28
26	If I had the time, I would like to play MMFWF regularly.	**1**	**2**	**3**	**4**	**5**		29
27	When we got going with MMFWF, I enjoyed it so much that I didn't want to stop.	**1**	**2**	**3**	**4**	**5**		30
28	I think I remember quite a lot of what I have learned by playing MMFWF.	**1**	**2**	**3**	**4**	**5**		31
29	It would be more enjoyable to play MMFWF with a couple of friends than to play a CD-ROM version on my own.	**1**	**2**	**3**	**4**	**5**		32
30	I felt frustrated when I couldn't give answers as quickly as my team mates.	**1**	**2**	**3**	**4**	**5**		33
31	MMFWF was a waste of time to me.	**1**	**2**	**3**	**4**	**5**		34
32	In addition to the questions and answers, I have learned a lot about medical microbiology from the photographs on the back of the cards.	**1**	**2**	**3**	**4**	**5**		35
33	It would have been meaningful to me to play MMFWF while I was busy with the MJR 224 module.	**1**	**2**	**3**	**4**	**5**		36
34	I think play (in general) can be applied as a meaningful learning opportunity.	**1**	**2**	**3**	**4**	**5**		37
35	While we were playing MMFWF, I forgot about other worries.	**1**	**2**	**3**	**4**	**5**		38
36	I think students will find it meaningful to play MMFWF after they have already completed the MJR 224 module.	**1**	**2**	**3**	**4**	**5**		39
37	MMFWF was a challenge to me.	**1**	**2**	**3**	**4**	**5**		40
38	I felt frustrated when I couldn't remember quickly what I had learned in MJR 224.	**1**	**2**	**3**	**4**	**5**		41
39	While we were playing MMFWF, my attention and concentration were completely absorbed by it.	**1**	**2**	**3**	**4**	**5**		42
40	The purpose of MMFWF was clear to me.	**1**	**2**	**3**	**4**	**5**		43
41	During the game I continuously received feedback with regard to my knowledge of medical microbiology.	**1**	**2**	**3**	**4**	**5**		44
42	I felt in control while we were playing MMFWF.	**1**	**2**	**3**	**4**	**5**		45

1 not at all	2 to a small degree	3 uncertain	4 to a fair degree	5 completely

							Office use	
43	I felt self-conscious while we were playing MMFWF.	**1**	**2**	**3**	**4**	**5**		46
44	I couldn't believe how quickly time passed while we were playing MMFWF.	**1**	**2**	**3**	**4**	**5**		47
45	I agree with the statement that learning can take place optimally during an informal, non-threatening learning opportunity.	**1**	**2**	**3**	**4**	**5**		48
46	MMFWF stimulated me to do more reading on certain topics.	**1**	**2**	**3**	**4**	**5**		49
47	I felt despaired after playing MMFWF because I couldn't answer many of the questions.	**1**	**2**	**3**	**4**	**5**		50
48	I used the score card to follow up on problem areas.	**1**	**2**	**3**	**4**	**5**		51
49	MMFWF had a positive influence on my perception of medical microbiology.	**1**	**2**	**3**	**4**	**5**		52
50	MMFWF helped me to identify shortcomings in my knowledge of medical microbiology.	**1**	**2**	**3**	**4**	**5**		53
51	The answers that I didn't know during the game, I looked up afterwards.	**1**	**2**	**3**	**4**	**5**		54
52	I think the score card can be used in a meaningful way to monitor one's progress.	**1**	**2**	**3**	**4**	**5**		55
53	It was great fun to play MMFWF.	**1**	**2**	**3**	**4**	**5**		66
54	It was not nice to me when my team mate(s)/opponents became too competitive.	**1**	**2**	**3**	**4**	**5**		57
55	I think MMFWF can be applied in a meaningful way during group work sessions.	**1**	**2**	**3**	**4**	**5**		58

Indicate at the following items NO (1), UNCERTAIN (2) or YES (3):

					Office use	
56	I think students will benefit from playing MMFWF on a regular basis.	**1**	**2**	**3**		59
57	I think when I am qualified one day and practice as a doctor, I will reach a point where I know enough about medical microbiology and infectious diseases.	**1**	**2**	**3**		60
58	Playing MMFWF on a regular basis will help me to become a life-long learner in medical microbiology.	**1**	**2**	**3**		61
59	I would like to have my own set of the MMFWF board game.	**1**	**2**	**3**		62
60	Only students who obtained good marks for MJR 224 would be able to enjoy playing MMFWF.	**1**	**2**	**3**		63

61. Indicate below the range that represents the final mark you obtained for MJR 224 (Infections). ***Office use***

50–59%	1
60–69%	2
70–74%	3
75–79%	4
80–85%	5
>85%	6

☐ 64

62. Use this opportunity to give any comments/recommendations/criticism with regard to the following aspects of the MMFWF board game. PLEASE <u>MOTIVATE</u> YOUR FEEDBACK AS FAR AS POSSIBLE.

(a) PHYSICAL APPEARANCE OF THE BOARD AND/OR QUESTION-AND ANSWER CARDS

Is the size of the board/cards comfortably manageable? Yes | No ☐ 65

_____

Is the visual material ("view back of card" images) meaningful and informative? Yes | No ☐ 66

_____

_____

(b) RULES OF THE GAME

Do you have any suggestions regarding additional rules that could possible promote/improve the playing process? Yes | No ☐ 67

_____

_____

(c) DEGREE OF DIFFICULTY

Do you think the questions were too difficult <u>in general</u>? Yes | No ☐ 68

_____

_____

Do you think only <u>certain</u> questions were too difficult? Yes | No ☐ 69

_____

_____

(d) ***CONTENT OF THE QUESTIONS AND ANSWERS*** ***Office use***

Would it be meaningful if the question-and-answer cards were printed on two different colors, where the one color would contain only basic knowledge and the other color more advanced questions and answers? Yes | No ☐ 70

_____

_____

(e) ***SPECIFIC CATEGORIES***

Was there any category in which the questions were particularly difficult? Yes | No ☐ 71

_____

Was there any category of which the questions were particularly informative and/or interesting? Yes | No ☐ 72

_____

(f) ***GENERAL REMARKS/SUGGESTIONS/CRITICISM***

_____

_____

_____

_____

_____

_____

☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ***THANK YOU!!*** ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺

UNIVERSITEIT VAN DIE VRYSTAAT
FAKULTEIT GESONDHEIDSWETENSKAPPE
DEPARTEMENT MEDIESE MIKROBIOLOGIE
AFDELING ONDERWYSONTWIKKELING

VRAELYS II

VRAELYS AAN M.B.,Ch.B. III STUDENTE IN DIE FAKULTEIT GESONDHEIDSWETENSKAPPE, UNIVERSITEIT VAN DIE VRYSTAAT, BLOEMFONTEIN, TEN OPSIGTE VAN DIE EVALUERING VAN DIE BORDSPEL* MED MICRO FUN WITH FACTS *AS 'N AANVULLENDE LEERMETODE IN DIE VAK MEDIESE MIKROBIOLOGIE

ALGEMENE INLIGTING VIR VOLTOOIING VAN DIE VRAELYS

1. **DANKIE VIR U DEELNAME AAN DIE BEKENDSTELLINGSFASE VAN DIE MED MICRO FUN WITH FACTS BORDSPEL.**

2. Hierdie vraelys bevat 62 items en bestaan uit vier en 'n half (4½) bladsye. Die voltooiing daarvan behoort nie meer as 30 minute van u tyd in beslag te neem nie.

3. Die doel van die vraelys is om op grond van u terugvoer die MED MICRO FUN WITH FACTS bordspel as 'n potensiële, aanvullende leermetode in Mediese Mikrobiologie te evalueer.

4. U respons en voorstelle sal ook verder aangewend word vir die afwerking van en, indien nodig, aanpassings aan die speletjie vir toekomstige gebruik deur voorgraadse mediese studente.

5. Die vraelys word anoniem voltooi en die inhoud daarvan is streng vertroulik. **GEBRUIK ASSEBLIEF <u>DIESELFDE NOMMER</u> OP DIE VRAELYS (p. 2, REGS BO, BLOKKIES 1–3) AS WAT VIR VRAELYS I AAN U TOEGEKEN IS** ten einde die twee vraelyste te koppel.

6. Die inligting wat met behulp van hierdie vraelys bekom word, is die intellektuele eiendom van die Universiteit van die Vrystaat en sal in 'n navorsingsprojek wat deur die navorser onderneem word, ten einde die graad Ph.D. (Gesondheidsberoepeonderwys) te behaal, aangewend word.

7. Betekenisvolle aanwending van inligting wat deur middel van die vraelys bekom word, is afhanklik van u korrekte, **<u>eerlike</u>** en deeglike voltooiing daarvan.

Baie dankie vir u samewerking. Wees asseblief verseker daarvan dat hierdie studie nie moontlik sou wees sonder u terugvoer en insette nie. Dit word opreg waardeer.

_____

M. C. STRUWIG

EVALUERING VAN MMFWF AS 'N AANVULLENDE LEERMETODE IN MEDIESE MIKROBIOLOGIE

			1–3

Lees elkeen van die onderstaande items deur en merk met behulp van 'n kruisie (X) op 'n skaal van 1 – 5 tot watter mate elkeen van die stellings u belewenis van die Med Micro Fun with Facts bordspel (voortaan verkort na "MMFWF") weerspieël, soos hieronder uiteengesit:

- indien die stelling ***glad nie*** u belewenis van MMFWF verteenwoordig/weerspieël nie, merk ***1;***
- indien die stelling ***in 'n geringe mate*** u belewenis van MMFWF verteenwoordig/weerspieël, merk ***2;***
- indien u ***onseker*** is, merk ***3;***
- indien die stelling ***tot 'n redelike mate*** u belewenis van MMFWF verteenwoordig/weerspieël, merk ***4;***
- indien die stelling ***volkome*** u belewenis van MMFWF verteenwoordig/weerspieël, merk ***5.***

LET WEL: U WORD VRIENDELIK VERSOEK OM SOVER AS MOONTLIK 'N DEFINITIEWE KEUSE TE MAAK EN *OPSIE 3* TE KIES SLEGS AS U REGTIG ONSEKER IS EN NIE OORTUIG IS DAT DIE STELLING VERTEENWOORDIGEND, OF NIE VERTEENWOORDIGEND VAN U BELEWENIS VAN DIE BORDSPEL IS NIE.

1 glad nie	**2 tot 'n geringe mate**	**3 onseker**	**4 tot 'n redelike mate**	**5 volkome**

							Kantoor-gebruik	
1	Die inhoud (vrae en antwoorde) van MMFWF was vir my sinvol.	**1**	**2**	**3**	**4**	**5**		4
2	Ek het heelwat nuwe kennis van mediese mikrobiologie bekom deur MMFWF te speel.	**1**	**2**	**3**	**4**	**5**		5
3	Ek het die reëls van MMFWF goed verstaan.	**1**	**2**	**3**	**4**	**5**		6
4	Die blootstelling aan MMFWF het my laat besef dat ek nog baie oor mediese mikrobiologie het om te leer.	**1**	**2**	**3**	**4**	**5**		7
5	Ek hou van bordspeletjies.	**1**	**2**	**3**	**4**	**5**		8
6	Ek sal dit verkies om op my eie 'n CD-ROM weergawe van MMFWF speel.	**1**	**2**	**3**	**4**	**5**		9
7	Dit werk goed om MMFWF in 'n span van twee of drie, in plaas van individueel, te speel.	**1**	**2**	**3**	**4**	**5**		10
8	MMFWF het my laat besef hoe min ek onthou van dít wat ek in module MJR 224 (Infeksies) geleer het.	**1**	**2**	**3**	**4**	**5**		11
9	Daar was aktiewe groepinteraksie terwyl ons MMFWF gespeel het.	**1**	**2**	**3**	**4**	**5**		12
10	Ek voel meer entoesiasties oor mediese mikrobiologie vandat ek MMFWF gespeel het.	**1**	**2**	**3**	**4**	**5**		13
11	Ek het ongemaklik gevoel as ek nie dadelik 'n vraag kon beantwoord nie.	**1**	**2**	**3**	**4**	**5**		14
12	Ek was bang my mede-studente sal 'n negatiewe beeld van my hê as ek 'n verkeerde antwoord gee.	**1**	**2**	**3**	**4**	**5**		15
13	Studente sal die feite van mediese mikrobiologie op 'n ontspanne, informele manier met behulp van MMFWF kan bemeester.	**1**	**2**	**3**	**4**	**5**		16
14	Ek sal verkies om MMFWF individueel in plaas van in 'n span van twee of drie te speel.	**1**	**2**	**3**	**4**	**5**		17
15	Ek het gespanne gevoel terwyl ek MMFWF gespeel het.	**1**	**2**	**3**	**4**	**5**		18
16	MMFWF sal studente kan help om hulle kommunikasievaardighede te verbeter.	**1**	**2**	**3**	**4**	**5**		19

1 glad nie	2 tot 'n geringe mate	3 onseker	4 tot 'n redelike mate	5 volkome

							Kantoor-gebruik	
17	MMFWF sal studente kan help om hulle kennis van mediese mikrobiologie verbaal weer te gee.	**1**	**2**	**3**	**4**	**5**		20
18	Van die vrae het spontane groepbesprekings uitgelok.	**1**	**2**	**3**	**4**	**5**		21
19	Die konsep waarvolgens MMFWF ontwikkel is, kan ook vir ander modules aangepas word.	**1**	**2**	**3**	**4**	**5**		22
20	MMFWF kan 'n nuttige leerinstrument vir studente in mediese mikrobiologie wees.	**1**	**2**	**3**	**4**	**5**		23
21	MMFWF skep 'n geleentheid vir studente om kennis met mede-studente uit te ruil.	**1**	**2**	**3**	**4**	**5**		24
22	Ek is van nature kompeterend.	**1**	**2**	**3**	**4**	**5**		25
23	Die visuele aspek van MMFWF (foto's op die agterkant van die kaartjies) het die vrae vir my duideliker gemaak.	**1**	**2**	**3**	**4**	**5**		26
24	Ek het deur MMFWF besef hoe wyd die veld van mediese mikrobiologie werklik is.	**1**	**2**	**3**	**4**	**5**		27
25	MMFWF was vir my vervelig.	**1**	**2**	**3**	**4**	**5**		28
26	Ek sal graag as ek tyd het, MMFWF wil speel.	**1**	**2**	**3**	**4**	**5**		29
27	Toe ons eers op dreef was met MMFWF, het ek dit so geniet dat ek nie wou ophou nie.	**1**	**2**	**3**	**4**	**5**		30
28	Ek dink ek onthou heelwat van dít wat ek deur MMFWF geleer het.	**1**	**2**	**3**	**4**	**5**		31
29	Dit sal vir my lekkerder wees om MMFWF saam met 'n paar vriende te speel as 'n CD-ROM weergawe op my eie.	**1**	**2**	**3**	**4**	**5**		32
30	Ek het gefrustreerd gevoel as ek nie so vinnig soos my spanmaats die antwoorde kon gee nie.	**1**	**2**	**3**	**4**	**5**		33
31	MMFWF was vir my 'n mors van tyd.	**1**	**2**	**3**	**4**	**5**		34
32	Ek het bykomend tot die vrae en antwoorde ook baie oor mediese mikrobiologie geleer deur die foto's op die agterkant van die kaartjies.	**1**	**2**	**3**	**4**	**5**		35
33	Dit sou vir my sinvol wees om MMFWF te speel terwyl ek besig was met die MJR 224 module.	**1**	**2**	**3**	**4**	**5**		36
34	Ek dink speel (in die algemeen) kan sinvol as 'n leergeleentheid aangewend word.	**1**	**2**	**3**	**4**	**5**		37
35	Terwyl ons besig was om MMFWF te speel, het ek vergeet van ander bekommernisse.	**1**	**2**	**3**	**4**	**5**		38
36	Ek dink dit sal vir studente sinvol wees om MMFWF te speel nadat hulle reeds MJR 224 afgehandel het.	**1**	**2**	**3**	**4**	**5**		39
37	MMFWF was vir my 'n uitdaging.	**1**	**2**	**3**	**4**	**5**		40
38	Ek het gefrustreerd geraak as ek nie vinnig kon onthou wat ek in MJR 224 geleer het nie.	**1**	**2**	**3**	**4**	**5**		41
39	Terwyl ons MMFWF gespeel het, was my aandag en konsentrasie totaal daardeur geabsorbeer.	**1**	**2**	**3**	**4**	**5**		42
40	Die doel van MMFWF was vir my duidelik.	**1**	**2**	**3**	**4**	**5**		43

1 glad nie	2 tot 'n geringe mate	3 onseker	4 tot 'n redelike mate	5 volkome

							Kantoor-gebruik	
41	Tydens die spel het ek deurgaans terugvoer gekry t.o.v. my kennis in mediese mikrobiologie.	**1**	**2**	**3**	**4**	**5**		44
42	Ek het gevoel ek is in beheer terwyl ons MMFWF gespeel het.	**1**	**2**	**3**	**4**	**5**		45
43	Ek het selfbewus gevoel terwyl ons MMFWF gespeel het.	**1**	**2**	**3**	**4**	**5**		46
44	Ek kon nie glo hoe die tyd gevlieg het terwyl ons MMFWF gespeel het nie.	**1**	**2**	**3**	**4**	**5**		47
45	Ek stem saam met die stelling dat leer optimaal plaasvind tydens 'n informele, nie-bedreigende leergeleentheid.	**1**	**2**	**3**	**4**	**5**		48
46	MMFWF het my gestimuleer om meer oor sekere onderwerpe te gaan oplees.	**1**	**2**	**3**	**4**	**5**		49
47	Ek het wanhopig gevoel nadat ons MMFWF gespeel het omdat ek baie van die vrae nie kon beantwoord nie.	**1**	**2**	**3**	**4**	**5**		50
48	Ek het die telkaart ("score card") gebruik om probleemareas op te volg.	**1**	**2**	**3**	**4**	**5**		51
49	MMFWF het my belewenis van mediese mikrobiologie positief beïnvloed.	**1**	**2**	**3**	**4**	**5**		52
50	MMFWF het my gehelp om leemtes in my kennis van mediese mikrobiologie te identifiseer.	**1**	**2**	**3**	**4**	**5**		53
51	Ek het ná die tyd antwoorde gaan opsoek wat ek nie tydens die spel geken het nie.	**1**	**2**	**3**	**4**	**5**		54
52	Ek dink die telkaart sal sinvol gebruik kan word om 'n mens se vordering te monitor.	**1**	**2**	**3**	**4**	**5**		55
53	Dit was groot pret om MMFWF te speel.	**1**	**2**	**3**	**4**	**5**		56
54	Dit was vir my sleg as my spanmaat(s)/opponente té kompeterend geraak het.	**1**	**2**	**3**	**4**	**5**		57
55	Ek dink MMFWF kan sinvol aangewend word tydens groepwerksessies.	**1**	**2**	**3**	**4**	**5**		58

Merk by die volgende items NEE (1), ONSEKER (2) of JA (3):

					Kantoor-gebruik	
56	Ek dink studente sal baat vind daarby om MMFWF op 'n gereelde basis te speel.	**1**	**2**	**3**		59
57	Ek dink as ek eendag gekwalifiseer is en as dokter praktiseer, sal ek op 'n punt kom waar ek genoeg weet van mediese mikrobiologie en infektiewe siektes.	**1**	**2**	**3**		60
58	Deur gereeld MMFWF te speel, sal my kan help om 'n lewenslange leerder in mediese mikrobiologie te word.	**1**	**2**	**3**		61
59	Ek sal daarvan hou om my eie stel van die MMFWF-bordspel te hê.	**1**	**2**	**3**		62
60	Net studente wat goeie punte in MJR 224 behaal het, sal dit geniet om MMFWF te speel.	**1**	**2**	**3**		63

61. Dui hieronder aan in watter reeks die finale punt wat u vir MJR 224 (Infeksies) behaal het, gelê het.

Kantoorgebruik

50–59%	1
60–69%	2
70–74%	3
75–79%	4
80–85%	5
>85%	6

☐ 64

62. Gebruik hierdie geleentheid om enige opmerkings/aanbevelings/kritiek ten opsigte van die volgende aspekte van die MMFWF-bordspel te gee. <u>MOTIVEER</u> ASSEBLIEF SOVER AS MOONTLIK U TERUGVOER.

(a) FISIESE VOORKOMS VAN DIE BORD EN/OF VRAAG-EN-ANTWOORDKAARTE

Is die grootte van die bord/kaartjies gemaklik hanteerbaar? Ja | Nee ☐ 65

_____

Is die visuele materiaal ("view back of card" foto's) sinvol en leersaam? Ja | Nee ☐ 66

_____

_____

(b) REËLS VAN DIE SPEL

Het u enige voorstelle t.ov. addisionele reëls wat moontlik die speelproses kan bevorder/verbeter? Ja | Nee ☐ 67

_____

_____

(c) MOEILIKHEIDSGRAAD

Dink u die vrae was <u>oor die algemeen</u> te moeilik? Ja | Nee ☐ 68

_____

_____

Dink u net <u>sekere</u> vrae was te moeilik? Ja | Nee ☐ 69

_____

_____

(d) INHOUD VAN DIE VRAE EN ANTWOORDE

Sal dit sinvol wees as die vraag-en-antwoordkaarte op twee verskillende kleure gedruk word, waar die een kleur slegs basiese kennis en die ander kleur meer gevorderde vrae en antwoorde behels? Ja | Nee ☐ 70

_____

_____

(e) SPESIFIEKE KATEGORIEË ***Kantoorgebruik***

Is daar enige kategorie waarvan die vrae vir u besonder moeilik was? | Ja | Nee | ☐ 71

_____

Is daar enige kategorie wat vir u besonder leersaam en/of interessant was? | Ja | Nee | ☐ 72

_____

(f) ALGEMENE OPMERKINGS/VOORSTELLE/KRITIEK

_____
_____
_____
_____
_____
_____

☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ***BAIE DANKIE!!*** ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺

APPENDIX C

UNIVERSITY OF THE FREE STATE
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF MEDICAL MICROBIOLOGY
DIVISION FOR DEVELOPMENT OF STUDENT LEARNING

QUESTIONNAIRE III

QUESTIONNAIRE TO SECOND-YEAR STUDENTS IN THE MJR 224 (INFECTIONS) MODULE OF THE MBChB CURRICULUM, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF THE FREE STATE, BLOEMFONTEIN, WITH REGARD TO THE EVALUATION OF THE MULTIPLE CHOICE WEB-BASED VERSION OF THE* MED MICRO FUN WITH FACTS *(MMFWF) GAME AS A POTENTIAL SUPPLEMENTARY LEARNING AND SELF-ASSESSMENT TOOL FOR UNDERGRADUATE MEDICAL STUDENTS IN MICROBIOLOGY AND INFECTIOUS DISEASES

GENERAL INFORMATION FOR COMPLETION OF THE QUESTIONNAIRE

1. **THANK YOU FOR YOUR PARTICIPATION IN THE EVALUATION OF THE WEB-BASED VERSION OF THE MMFWF GAME.**

2. This questionnaire contains 53 items and consists of three (3) pages. Its completion should not require more than 20 minutes of your time.

3. The purpose of the questionnaire is to evaluate by means of your feedback, the computerised, web-based version of the Med Micro Fun With Facts game as a potential supplementary learning and self-assessment tool in the Infections module (MJR 224) of the undergraduate medical curriculum.

4. Your response and recommendations will also be used to finalise and, if necessary, adjust the game for future use by undergraduate medical students.

5. The questionnaire is completed anonymously and its content is strictly confidential.

6. The information obtained by means of this questionnaire is the intellectual property of the University of the Free State and will be applied in a research project undertaken by the researcher to obtain the degree Ph.D. (Health Professions Education).

7. Meaningful application of information obtained by means of this questionnaire depends on your correct, **honest** and thorough completion thereof.

Thank you for your co-operation. Please be assured that this study would not have been possible without your feedback and input. It is sincerely appreciated.

_____

Ms. DALEEN STRUWIG
Module leader MJR 224
Developer and intellectual proprietor of MMFWF

			1–3

EVALUATION OF THE MMFWF WEB-BASED VERSION OF THE GAME AS A SUPPLEMENTARY LEARNING AND SELF-ASSESSMENT TOOL IN MEDICAL MICROBIOLOGY AND INFECTIOUS DISEASES

Read through each of the following items and mark by means of a cross (X) on a scale of 1 – 5 to what extent the statement reflects your perceptions of the Med Micro Fun With Facts Multiple Choice computer game (henceforth abbreviated as "E-MMFWF"), as indicated below:

- if the statement does ***not at all*** reflect/represent your perception of the game, mark ***1;***
- if the statement ***to a small degree*** reflects/represents your perception of the game, mark ***2;***
- if you are ***uncertain,*** mark ***3;***
- if the statement ***to a fair degree*** reflects/represents your perception of the game, mark ***4;***
- if the statement ***completely*** reflects/represents you perception of the game, mark ***5.***

PLEASE NOTE: YOU ARE KINDLY REQUESTED TO MAKE A DEFINITIVE CHOICE AS FAR AS POSSIBLE AND CHOOSE *OPTION 3* ONLY IF YOU ARE REALLY UNCERTAIN AND NOT CONVINCED THAT THE STATEMENT IS REPRESENTATIVE OR NOT OF YOUR PERCEPTION OF THE COMPUTER GAME.

1 not at all	**2 to a small degree**	**3 uncertain**	**4 to a fair degree**	**5 completely**

							Office use	
1	I understood all the rules of E-MMFWF very well.	**1**	**2**	**3**	**4**	**5**		4
2	Students will be able to master the facts of medical microbiology in a relaxed, informal way by means of E-MMFWF.	**1**	**2**	**3**	**4**	**5**		5
3	E-MMFWF will help students to improve their computer skills.	**1**	**2**	**3**	**4**	**5**		6
4	The concept on which the development of E-MMFWF was based can also be applied to other modules.	**1**	**2**	**3**	**4**	**5**		7
5	E-MMFWF can be a useful learning instrument for students in medical microbiology.	**1**	**2**	**3**	**4**	**5**		8
6	E-MMFWF can be a useful self-assessment instrument for students in medical microbiology.	**1**	**2**	**3**	**4**	**5**		9
7	E-MMFWF was boring to me.	**1**	**2**	**3**	**4**	**5**		10
8	E-MMFWF was a waste of time to me.	**1**	**2**	**3**	**4**	**5**		11
9	I think play (in general) can be applied as a meaningful learning opportunity.	**1**	**2**	**3**	**4**	**5**		12
10	I think students will find it meaningful to play E-MMFWF while they are busy with the the MJR 224 module.	**1**	**2**	**3**	**4**	**5**		13
11	I agree with the statement that learning can take place optimally during an informal, non-threatening learning opportunity.	**1**	**2**	**3**	**4**	**5**		14
12	E-MMFWF may have a positive influence on students' perception of medical microbiology.	**1**	**2**	**3**	**4**	**5**		15
13	It was fun to play E-MMFWF.	**1**	**2**	**3**	**4**	**5**		16
14	I think E-MMFWF can be applied in a meaningful way when preparing for tests and exams.	**1**	**2**	**3**	**4**	**5**		17
15	I found the sound effects distracting.	**1**	**2**	**3**	**4**	**5**		18
16	The appearance of the game is stimulating to the senses (visually attractive).	**1**	**2**	**3**	**4**	**5**		19

1 not at all	2 to a small degree	3 uncertain	4 to a fair degree	5 completely

Office use

17	The graphic images/photographs (where available) were informative.	**1**	**2**	**3**	**4**	**5**		20
18	I think students will benefit from playing E-MMFWF on a regular basis.	**1**	**2**	**3**	**4**	**5**		21
19	The process of logging in and starting the game was clear.	**1**	**2**	**3**	**4**	**5**		22
20	The sound responses made me feel embarrassed.	**1**	**2**	**3**	**4**	**5**		23
21	I had difficulty locating the website where the game is posted.	**1**	**2**	**3**	**4**	**5**		24
22	The E-MMFWF computer game will help students to master new terminology.	**1**	**2**	**3**	**4**	**5**		25
23	I would prefer to play the game without sound.	**1**	**2**	**3**	**4**	**5**		26
24	The E-MMFWF game needs more graphic images and photographs.	**1**	**2**	**3**	**4**	**5**		27
25	The sound effects contributed positively to my experience of the game.	**1**	**2**	**3**	**4**	**5**		28
26	I experienced positive emotions while playing E-MMFWF.	**1**	**2**	**3**	**4**	**5**		29
27	The exposure to E-MMFWF made me realise that I still have a lot to learn about medical microbiology	**1**	**2**	**3**	**4**	**5**		30
28	I like computer games in general.	**1**	**2**	**3**	**4**	**5**		31
29	I feel more enthusiastic about medical microbiology since I have played E-MMFWF	**1**	**2**	**3**	**4**	**5**		32
30	I felt uncomfortable when I couldn't answer a question immediately.	**1**	**2**	**3**	**4**	**5**		33
31	I felt nervous/stressed out while I played E-MMFWF	**1**	**2**	**3**	**4**	**5**		34
32	I am by nature quite competitive.	**1**	**2**	**3**	**4**	**5**		35
33	E-MMFWF made me realise that medical microbiology is an extremely vast field of study.	**1**	**2**	**3**	**4**	**5**		36
34	When I got going with E-MMFWF I enjoyed it so much that I didn't want to stop.	**1**	**2**	**3**	**4**	**5**		37
35	While I was playing E-MMFWF, I forgot about other worries.	**1**	**2**	**3**	**4**	**5**		38
37	E-MMFWF was a challenge to me.	**1**	**2**	**3**	**4**	**5**		39
38	I felt frustrated when I couldn't remember what I have studied.	**1**	**2**	**3**	**4**	**5**		40
39	While I was playing E-MMFWF, my attention and concentration were completely absorbed by it.	**1**	**2**	**3**	**4**	**5**		41
40	The purpose of E-MMFWF was clear to me.	**1**	**2**	**3**	**4**	**5**		42
41	I felt in control when I was playing E-MMFWF.	**1**	**2**	**3**	**4**	**5**		43
42	I couldn't believe how quickly time passed while I was playing E-MMFWF.	**1**	**2**	**3**	**4**	**5**		44

1 not at all	2 to a small degree	3 uncertain	4 to a fair degree	5 completely

Office use

43	E-MMFWF stimulated me to do more reading on certain topics.	**1**	**2**	**3**	**4**	**5**		45
44	I felt despaired after playing E-MMFWF because I couldn't remember many of the questions.	**1**	**2**	**3**	**4**	**5**		46
45	E-MMFWF had a positive influence on my perception of medical microbiology.	**1**	**2**	**3**	**4**	**5**		47
46	Only students who are doing well in MJR 224 will be able to enjoy E-MMFWF.	**1**	**2**	**3**	**4**	**5**		48
47	I played E-MMFWF more than the number of times required for directed learning.	**1**	**2**	**3**	**4**	**5**		49
48	I played more sessions than those that were required for directed learning.	**1**	**2**	**3**	**4**	**5**		50
49	I will access the E-MMFWF website even after I have successfully completed the MJR 224 module.	**1**	**2**	**3**	**4**	**5**		51
50	Accessing the E-MMFWF website on a regular basis will probably help me to develop lifelong learning skills in medical microbiology.	**1**	**2**	**3**	**4**	**5**		52
51	**I would say the exposure to the MMFWF web game (sessions 7-12) contributed positively to the increase in my marks from Test 1 to Test 2.**	**1**	**2**	**3**	**4**	**5**		53

52. Any suggestions/recommendations for improvement?

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53. Any other comments?

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☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ***THANK YOU!!*** ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺ ☺

..... and good luck with your exams!

APPENDIX D

MAJOR TEXTBOOKS USED FOR COLLECTION OF QUESTIONS AND ANSWERS, AND IMAGES, PHOTOGRAPHS AND DIAGRAMMES ADDED AS SUPPLEMENTARY MATERIAL TO SELECTED QUESTIONS IN THE GAME

BANNISTER BA, BEGG NT & GILLESPIE SH

2000. *Infectious Disease,* 2nd edition. Oxford: Blackwell Science.

BARROW GI & FELTHAM RKA, EDITORS

1993. *Cowan and Steele's Manual for the Identification of Medical Bacteria,* 3rd edition. Cambridge: Cambridge University Press.

BOYD RF

1995. *Basic Medical Microbiology,* 5th edition. Boston: Little, Brown and Company.

BROOKS GF, BUTEL JS & MORSE SA, EDITORS

1998. *Jawetz, Melnick and Adelberg's Medical Microbiology,* 21st edition. Stamford, Connecticut: Appleton & Lange.

CONTE JE JR

1995. *manual of Antibiotics and Infectious Diseases,* 8th edition. Bltimore: Williams & Wilkins.

CRISSEY JT, LANG H & PARISH LC

1995. *Manual of Medical Mycology.* Cambridge, Massachusetts: Blackwell Science.

DE HOOG GS, GUARRO J, GENÉ J & FIGUERAS MJ

2000. *Atlas of Clinical Fungi,* 2nd edition. Utrech: Centraalbureau Voor Schimmelcultures & Reus, Spain: Universitat Rovira i Virgili.

ELLIOTT T, HASTINGS M & DESSELBERGER U

1997. *Lecture Notes on Medical Microbiology,* 3rd edition. Oxford: Blackwell Science.

EMOND RTD & ROWLAND HAK

1987. *A Colour Atlas of Infectious Diseases,* 2nd edition. Ipswitch: Wolfe Medical Publications.

FARRAR WE, WOOD MJ, INNES JA & TUBBS H

1992. *Infectious Diseases Text and Color Atlas,* 2nd edition. London: Gower Medical Publishing.

FREY D, OLDFIELD RJ & BRIDGER RC

1979. *Colour Atlas of Pathogenic Fungi*. Sydney: Wolfe Medical Publications.

GILLESPIE S & BAMFORD K

2000. *Medical Microbiology and Infection at a Glance.* Oxford: Blackwell Science.

GREENWOOD D, SLACK R & PEUTHERER J
1997. *Medical Microbiology. A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control*, 15th edition. New York: Churchill Livingstone.

HASLETT C, CHILVERS ER, HUNTER JAA & BOON NA, EDITORS
1999. *Davidson's Principles and Practice of Medicine*, 18th edition. Edinburgh: Churchill Livingstone.

HOH HB & EASTY DL
1995. *Clinical cases in Ophthalmology*. Oxford: Butterworth-Heinemann.

HOWARD BJ, KEISER JF, WEISSFELD AS, SMITH TF & TILTON RC, EDITORS
1994. *Clinical and Pathogenic Microbiology,* 2nd edition. St. Louis: Mosby.

LABHART A
1974. *Clinical Endocrinology: Theory and Practice*. Berlin: Springer-Verlag.

LAMBERT HP & O'GRADY FW, EDITORS
1992. *Antibiotic and Chemotherapy,* 6th edition. Edinburgh: Churchill Livingstone.

LENNETTE EH, BALOWS A, HAUSLER WJ JR & SHADOMY HJ, EDITORS
1985. *Manual of Clinical Microbiology,* 4th edition. Washington, DC: Americal Society for Microbiology.

MANDELL GL, BENNETT JE & DOLIN R, EDITORS
2000. *Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases,* 5th edition, Volumes 1 & 2. New York: Churchill Livingstone.

MANDELL GL & DIAMOND RD, EDITORS
2000. *Atlas of Infectious Diseases. Fungal Infections*. Philadelphia: Current Medicine.

MARKELL EK & VOGE M
1976. *Medical Parasitology*, 4th edition. Philadelphia: WB Saunders Company.

MIMS C, PLAYFAIR J, ROITT I, WAKELIN D & WILLIAMS R
1998. *Medical Microbiology*, 2nd edition. London: Mosby.

NORA JJ & FRASER FC
1989. *Medical Genetics: Principles and Practice*, 3rd edition. Philadelphia: Lea & Febiger.

PARKER MT & COLLIER LH, EDITORS
1990. *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, 8th edition, Volumes 1–4. London: Edward Arnold.

SCHAECHTER M, MEDOFF G & EISENSTEIN, EDITORS
1993. *Mechanisms of Microbial Disease*,, 2nd edition. Baltimore: Williams & Wilkins.

SLEIGH JD & TIMBURY MC
1990. *Medical Bacteriology*, 3rd edition. Edinburgh: Churchill Livingstone.

STEDMAN'S
2000. *Stedman's Medical Dictionary*, 27th edition. Philadelphia: Lippincott Williams & Wilkins.

STROHL WA, ROUSE H & FISHER BD
2001. *Lippincott's Illustrated Reviews: Microbiology*. Philadelphia: Lippincott Williams & Wilkins.

TALARO KP & TALARO A
2002. *Foundations in Microbiology*, 4th edition. Boston: McGraw-Hill.

TIMBURY MC
1997. *Notes on Medical Virology*, 11th edition. New York: Churchill Livingstone.

YOUMANS GP, PATERSON PY & SOMMERS HM, EDITORS
1985. *The Biological and Clinical Basis of Infectious Diseases*, 3rd edition. Philadelphia: WB Saunders Company.

ZAMAN V
1980. *Atlas of Medical Parasitology*. Lancaster: MTP Press Limited.

APPENDIX E

INFECTIONS MODULE GUIDE WITH TOPICS COVERED DURING EACH HOUR OF THE SESSIONS PRESENTED IN THE MODULE

INFECTIONS MODULE GUIDE 2003–2004

Module code: *MJR224*
Module type: *Core*
Semester: *Four*
Contact time: *42 hours*
Directed learning: *42 hours*
Self-study time: *Minimum 56 hours*
Module leader: *Ms Daleen Struwig*

AIM

The aim of this module is to provide the second-year medical student with core knowledge regarding clinically relevant microorganisms (bacteria, viruses, fungi and parasites) and their role in infectious diseases. Furthermore, the student will obtain knowledge with regard to the diagnosis, treatment, prevention and control of infectious diseases, the implications of resistance to antimicrobial agents and the basic mechanisms of pathogenicity.

OUTCOMES

After completion of this module the student will be able to:

1. understand the relevance and importance of medical microbiology in primary and specialised patient care;
2. provide a basic classification of medically important microorganisms;
3. discuss bacteria, viruses, fungi and parasites with regard to morphology and structure, basic genetics where applicable, growth and metabolism, basic mechanisms of pathogenicity;
4. discuss the classification, targets and mechanisms of action and clinical application of antimicrobial agents, as well as the practical implications of resistance to antimicrobial agents (which include antibacterial, -viral, -fungal, -tuberculosis and -parasitic agents);

5. discuss the microbiology, epidemiology, pathogenesis, clinical signs and symptoms, laboratory diagnosis, treatment and prevention of infectious diseases caused by the following groups of organisms:
   (a) mycobacteria;
   (b) Gram positive bacteria, including staphylococci, streptococci, enterococci, corynebacteria, *Bacillus* spp. and *Listeria* spp.;
   (c) Gram negative bacteria, including the Enterobacteriaceae, parvobacteria (*Haemophilus* spp., *Bordetella pertussis*, *Brucella* spp.), *Pseudomonas* spp., *Acinetobacter* spp. and other clinically relevant Gram-negative bacilli;
   (d) anaerobic bacteria;
   (e) bacterial, viral, fungal and parasitic zoonoses;
6. discuss clinical virology with regard to causes, epidemiology, signs and symptoms, treatment and prevention of the following infections:
   (a) viral diseases of children;
   (b) respiratory (including influenza) and gastrointestinal virus infections;
   (c) arboviruses; hemorrhagic virus infections;
   (d) prions, slow and oncogenic viruses.

PRE-REQUISITES

All modules of Phase I as well as the modules of Semester 3, Phase II.

STRUCTURE OF THE MODULE

SESSION 1: INTRODUCTORY BACTERIOLOGY

Lecture (1 hour):	*Classification, structure and morphology of bacteria.*
Lecture (1 hour):	*Genetics, growth and metabolism of bacteria.*
Lecture (1 hour):	*Basic mechanisms of pathogenicity.*
Directed learning:	*Normal flora of humans; infection cycle; route of transmission.*

SESSION 2: INTRODUCTORY VIROLOGY

Lecture (1 hour):	*Classification, structure and morphology of viruses.*
Lecture (1 hour):	*Virus replication; viral infections in humans.*
Group/Workbook (1 hour):	*Diagnostic methods in virology.*
Directed learning:	*Epidemiology; transmission of viruses; principles of immunization.*

SESSION 3: INTRODUCTORY MYCOLOGY

Lecture (1 hour):	*Classification, structure and morphology of fungi; superficial and deep mycoses.*
Lecture (1 hour):	*Clinical features of fungal infections: slide presentation.*
Group/Workbook (1 hour):	*Laboratory diagnosis of fungal infections.*
Directed learning:	*Opportunistic fungal infections; predisposing factors.*

SESSION 4: INTRODUCTORY PARASITOLOGY

Lecture (1 hour):	*Classification, structure and morphology of parasites.*
Lecture (1 hour):	*Life-cycles of core-important parasites.*
Group discussion (1 hour):	*Slides show of medical parasites.*
Directed learning:	*Epidemiology, prevention and complications of parasitic infections.*

SESSION 5: ANTIMICROBIAL AGENTS I

Lecture (1 hour):	*Different classes of antibacterial agents; targets (mechanisms of action).*
Lecture (1 hour):	*Bacterial mechanisms of resistance to antimicrobial agents.*
Group/Workbook (1 hour):	*Clinical application; spectrum of activity; specific indications.*
Directed learning:	*Implications of resistance to antimicrobial agents.*

SESSION 6: ANTIMICROBIAL AGENTS II

Lecture (1 hour):	*Antiviral agents.*
Lecture (1 hour):	*Antifungal agents.*
Lecture (1 hour):	*Antiparasitic agents.*
Directed learning:	*Treatment of specific viral, fungal and parasitic infections.*

SESSION 7: MYCOBACTERIA

Lecture (1 hour):	*Clinical features, course and complications of tuberculosis.*
Lecture (1 hour):	*Mycobacteria other than tuberculosis (MOTT); Actinomyces; Nocardia.*
Workbook (1 hour):	*Antituberculosis agents; problems regarding resistance (MDRMT); laboratory diagnosis of tuberculosis.*
Directed learning:	*Mycobacterial infections in immune-compromised patients; DOTS.*

SESSION 8: GRAM POSITIVE BACTERIA

Lecture (1 hour):	*Staphylococci; staphylococcal infections; laboratory diagnosis; treatment.*
Lecture (1 hour):	*Streptococci and enterococci; streptococcal and enterococcal infections; laboratory diagnosis; treatment.*
Workbook (1 hour):	*Other clinically important Gram positive bacteria: Corynebacterium, Bacillus, Listeria.*
Directed learning:	*Case studies; complications of Gram positive infections.*

SESSION 9: GRAM NEGATIVE BACILLI

Lecture (1 hour):	*Enterobacteriaceae.*
Workbook (1 hour):	*Parvobacteria.*
Workbook (1 hour):	*Pseudomonas and other Gram negative bacilli.*
Directed learning:	*Intensive care unit infection: Acinetobacter, Stenotrophomonas, Pseudomonas; case studies.*

SESSION 10: ANAEROBIC BACTERIA

Lecture (1 hour):	*Clostridia and other Gram positive anaerobes.*
Lecture (1 hour):	*Gram negative anaerobes.*
Workbook (1 hour):	*Laboratory diagnosis and treatment of anaerobic infections.*
Directed learning:	*Case studies.*

SESSION 11: BACTERIAL, FUNGAL AND PARASITIC ZOONOSES

Lecture (1 hour):	*Brucellosis, Coxiella, psittacosis.*
Lecture (1 hour):	*Rickettsia, Ehrlichia, Bartonella, Borrelia.*
Workbook (1 hour):	*Anthrax, toxoplasmosis, fungal zoonoses.*
Directed learning:	*Fever of unknown origin.*

SESSION 12: VIRAL ZOONOSES

Lecture (1 hour):	*Hemorrhagic fever; arboviruses.*
Lecture (1 hour):	*Rabies.*
Group/Workbook (1 hour):	*Case studies: hemorrhagic viruses.*
Directed learning:	*Differential diagnosis of bleeding tendency associated with fever.*

SESSION 13: CLINICAL VIROLOGY I

Lecture (1 hour):	*Respiratory and gastrointestinal viral infections.*
Lecture (1 hour):	*Herpes viruses.*
Directed learning:	*Influenza viruses: treatment, prevention, immunization.*

SESSION 14: CLINICAL VIROLOGY II

Lecture/Workbook (1 hour):	*Viral infections in children.*
Group/Workbook (1 hour):	*Perinatal and congenital infections.*
Workbook (1 hour):	*Prions; slow virus infections; papova viruses.*
Directed learning:	*Oncogenic viruses.*

FINAL THOUGHTS

The master in the art of living makes little distinction between his work and his play, his labour and his leisure…. He hardly knows which is which. He simply pursues his vision of excellence at whatever he does, leaving others to decide whether he is working or playing. To him he's always doing both.

Zen Buddhist saying

Only the curious will learn and only the resolute will overcome the obstacles to learning. The quest quotient has always excited me more than the intelligence quotient.

Eugene S. Wilson

Be daring, be different, be impractical, be anything that will assert integrity of purpose and imaginative vision against the play-it-safers, the creatures of commonplace, the slaves of the ordinary!

Sir Cecil Beaton

If money is your hope for independence, you will never have it. The only real security that a man can have in this world is a reserve of knowledge, experience and ability.

Henry Ford