Teaching of an integrated human nervous system course in the Sultanate of Oman

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ABSTRACT

The College of Medicine at Sultan Qaboos University, Muscat, Oman has opted for the credit system that makes the designing of an integrated, multidisciplinary course a challenging proposition. The human nervous system course is no exception to that. The aim of the course is to guide students to understand the structure and function of the brain and to learn about the disorders afflicting it. There are 4 major problems encountered in this course. First, due to the relative weighting of different subjects in the course, the students tend to ignore the topics that have less credit hours and contribute fewer marks to the total marks. Secondly, students make minimal effort to analyze and synthesize information. Thirdly, poor knowledge of the English language hampers comprehension. Finally, it is felt that in its present form the course is too long. We are trying to evolve a version of hybrid problem-based learning that suits our local needs and resources.

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Sultan Qaboos University (SQU) College of Medicine started functioning in 1986 as a national center for training future medical doctors. The College of Medicine conducts a 7-year MD program and follows the semester calendar. An academic year consists of 2 full semesters, an autumn semester and a spring semester. A full semester comprises of 15 weeks whilst a short summer semester lasts for 8 weeks. Summer courses are offered on the basis of student needs. Students who fall behind, or are under academic probation can take advantage of this opportunity. During the first 3 semesters, students take various courses that are prerequisites for the College of Medicine courses. These courses are held in the College of Science and the Language Center. Sultan Qaboos University College of Medicine has opted for the credit system. This system is based on student-teacher contact time and course load. The progress of a student during a particular semester is assessed on the basis of allocated numerical values for the grade results of the course. This enables the calculation of Grade Point Averages (GPA); a semester GPA, based on a particular semester's work, and a cumulative GPA, based on the summated GPA to date. These are used as indicators for the progress of the students, and failing to achieve a certain level (GPA=2) would imply that a student is not performing to the required standards. A probational status for such students puts them under intense academic supervision and with the help of their academic advisors, course selection and reduced load is carefully worked out.

English is the language of instruction in SQU College of Medicine and students are expected to achieve proficiency in the English language before starting the medical courses. Intensive English courses are offered to students to acquire the band 4 level (English Language Assessment Test, Cambridge) in the English language. One Arabic language course, 2 university compulsory courses (for example physics or chemistry) and 4 university electives are required as a part of the entire MD curriculum. Three basic science subjects (chemistry, physics and biology courses) provide the foundation for the College of Medicine courses.

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Medical courses in the MD program. The medical courses are classified into 4 different categories. The first category contains the foundation courses (for example metabolism, general pharmacology, and so forth). The second category is made-up of systems courses. This class comprises system based multidisciplinary courses. These are truly integrated, and problem based courses (for example, human nervous system [HNS]). The third category consists of an integrated lecture series (ILS) for clinical students (taught during the clinical years). The fourth category consists of rotations through various clinical disciplines. The preclinical curriculum is based on human systems and the proper integration of the various basic medical sciences such as anatomy, physiology, biochemistry, and pharmacology. The knowledge of preclinical subjects is further reinforced in the ILS during the clinical years. At the SQU College of Medicine, the teaching leans towards problem based learning (PBL) and clinical information is introduced early in the curriculum. Much of the teaching is carried out as seminars and tutorials involving only a small number of students. Active student participation is very much encouraged.

Medical students take part in village health studies during the inter semester break. This provides early exposure to clinical medicine and a proper context for the teaching of basic medical sciences. This encourages students to develop a more holistic approach to medicine, a better perception of the community's medical needs, local cultural nuances and religious intricacies.[1] Direct contact between the students and the community at an early stage of medical training is unique to SQU and strengthens the preclinical curriculum considerably.[2] In addition, the students are offered a summer overseas elective program at the end of the sixth year.[3] An important feature of the SQU MD program is the involvement of clinicians along with medical scientists, in small group tutorials, to discuss the scientific principles underlying various clinical problems.

Aims and objectives of the HNS course. Perhaps the ultimate objective of modern neuroscience is to comprehend the biological basis of consciousness and other higher mental attributes. Disorders of the brain and mind are some of the worst diseases remaining to be conquered. The triumph of the idea that the cause of these disorders may lie in the altered anatomy, physiology and molecular biology of the brain has led to contributions of immense clinical importance. These developments also hold great promise for designing new strategies for teaching neuroscience to our future doctors. Neuroscience is now a well-established discipline encompassing neuroanatomy, neurophysiology, neuropharmacology, neurology, psychiatry and neuroradiology.[4] This new integrative approach to teaching neuroscience attempts to liberate brain studies from the artificial constraints imposed by rigid compartmentalization of subject-based teaching. This integrative method puts more emphasis on conceptualization rather than the mere memorization of facts. A lecture dominated, departmentally run medical curriculum is being replaced by a multi-modal, goal-oriented fully integrated teaching program.

There are 2 important principles of brain organization. One that the brain has a high degree of specificity of synaptic connections – a neural circuit diagram of the brain (considered to be controlled by genetic and other developmental programs). The other important principle is that brain wiring is also highly plastic and changes with experience (for example, learning, controlled by environmental determinants). Development of human behavior is a gradual process that results from the interaction between nature (innate factors) and nurture (emotional and intellectual environment). A clear understanding of both these factors acquires great clinical significance for the better management of brain disorders. This present course encourages medical students to look at the brain in a new way, a way that unites its biological and social dimensions.[5]

The departments of anatomy, physiology and pharmacology and to a lesser extent neurology and radiology collaborate in teaching this neuroscience course. The present course is designed to guide students to understand the brain and the mind in all its dimensions. The aim of the neuroscience course is to make medical students comprehend how we perceive, move, talk, remember, think, feel pleasure, get angry and the pathophysiology of the major disorders that afflict these brain functions. Knowledge of neuroanatomy, neurophysiology and neuropharmacology are clearly of great importance in understanding the functions of the nervous system, the malfunctions and their treatments. Strategies to enhance the value of basic science concepts in designing specific objectives of a medical curriculum have now been recognized and stressed. Previously, the presentation of basic sciences mainly emphasized acquisition of basic science knowledge rather than the utility of such information. The objectives of the HNS course at the SQU College of Medicine have been designed keeping in mind the importance of the basic sciences in understanding clinical neurology. The objectives are as follows: 1. To provide students with a sound knowledge of the structure and function of the nervous system. 2. To help students comprehend the mechanisms of information coding by sensory receptors, and the processing of information at the higher levels of the nervous system for conscious perception. 3. To help students understand the organization of the motor system; from a simple reflex to complex motor behavior, its disorders and pharmacology. 4. To develop an understanding of the autonomic nervous system, its functions and dysfunctions. 5. To appreciate an integrated action of the brain. 6. To illustrate how complex human

behavior can be localized to specific regions of the brain and how far behavior can be understood in terms of the properties of nerve cells and their interconnections. 7. To understand the scientific basis of the actions of important drugs used in the management of patients with neurological and psychiatric disorders. 8. To understand recent advances in molecular neurobiology. 9. To encourage medical students to look at the brain in a new way that unites its biological and social dimensions (a continuum from neuron to behavior, where psychology is firmly rooted in empirical neuroscience).

Content of the HNS. The HNS is taught in the seventh semester (fourth year) of the pre-clinical medical curriculum. This course in its present format was introduced in 1997. The duration of this course is 15 weeks. Each week there are 4, 50-minute lectures (sometimes 3 lectures) and one practical class (each lasting 2 hours). There are 52 lectures in the HNS course. Some of the topics covered in the lectures include: the development of the nervous system, neurohistology, receptors and the processing of information, physiology of pain, physiology of taste, physiology of speech, the limbic system, the cranial nerves, upper and lower motor neuron lesions, local and general anesthetics, opioids and drug abuse, and so forth. There are 12 practical classes, each consisting of 2 groups and each class lasting for 2 hours. These laboratory classes provide "hands on" training and experience in neurological examination; access to fixed, prosected material (dissected brains and spinal cords, histological sections, models), photographs of normal and pathological specimens and radiological material. Some of the topics in the practical sessions are: topography of the brain, sensory and motor examination, sections of cerebral hemispheres and functional areas, electromyography and nerve conduction, visual tests, the orbit and eye, the ear and temporal bone, hearing tests and so forth. Laboratory experiments are effectively used in conjunction with interpretive reports and discussions. Also, there are 6 clinical case presentations by the students in the HNS course. These paper cases are organized every second week of the course, in groups of 30 students (we are trying to reduce the number of students in each group to 8, but at the moment shortage of faculty members precludes us from such an arrangement). In each group 5 or 6 students prepare and present the case to the remaining students. In these student–centered, self-learning seminars, which are supervised by 3 tutors from different disciplines, students are highly encouraged to research, present and discuss various clinical topics along with the basic medical sciences. Each clinical case presentation is followed by a quiz to assess the students.

Assessment of the student's performance. To evaluate the performance of the student in this course, the assessment is divided into 2 parts. The in-course assessments contribute 40%, while the final examination contributes 60% of the total marks allocated for the course (**Figure 1**). For different sections of the course different modes of evaluation are followed. Laboratory reports, and presentations in tutorials are marked for various components of the course. The written examinations include A type, K type and matching type multiple-choice questions (MCQ's) and short essays. The final examination consists of 2 parts, A and B, and carries 60% of the total marks. Part A includes MCQ's, labeling of diagrams and short essays. This part accounts for 70% of the total mark allocated for the final examination. Part B is based on a clinical case and accounts for the remaining 30% of the marks (**Figure 1**). Eventually, all the marks are collated to produce one final result (**Table 1**). By this method, the student is evaluated

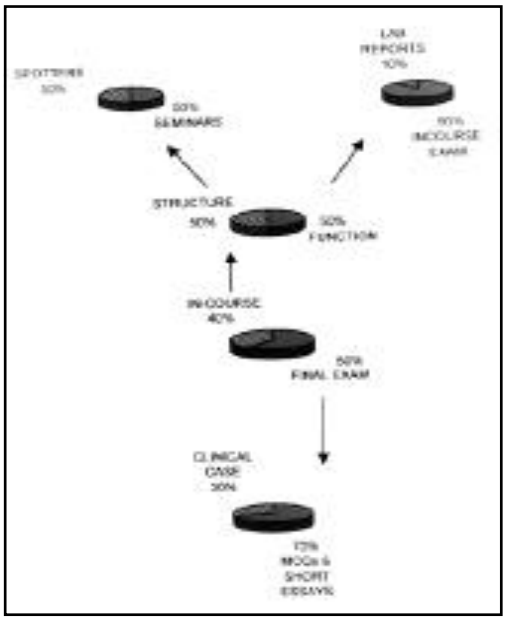

Figure 1 - Pie charts showing the break down of the total marks into the in-course and the end-course examination along with the percentage of the marks allocated for the different components of in-course assessments and end-course examination. MCQs - multiple choice questions

Table 1 - Showing a typical distribution of final marks.

Grade	N of students
A (93-100)	2
A- (90-92)	5
B+ (87-89)	2
B (83-86)	8
B- (80-82)	14
C+ (77-79)	12
C (73-76)	10
C- (70-72)	5
D+ (65-69)	5
D (60-64)	1
F (<60)	4

continuously throughout the course. In the SQU College of Medicine there is a system in place, which ensures a comprehensive evaluation of all the courses and tutors by the students regularly. Students appreciate this course and like it very much, especially the clinical case presentations. However, a small percentage of students do complain about difficulty and the length of the course. The students are partly correct in their assessment of the length of the course and work is being carried out to cut down the unwanted details from the course. This course has been evaluated every year since its inception. It is consistently ranked among the top 5 courses in the medical college (ranking tends to vary from second to fifth place).

Problems associated with teaching and learning. There are several problems that have been experienced in this course. Since the College has opted for the credit system, designing an integrated, multidisciplinary course such as the HNS becomes a very difficult proposition. We find it extremely troublesome to tailor a course to suit the precise requirements for credit allocation, especially when one tries to develop an integrated course based on the input from different departments. Often, our scientific naivety and the very strong territorial loyalties to our respective subjects and departments prevent us from adopting a truly integrated approach. Similar problems in changing the curriculum have also been encountered by others.[6] In such situations we are forced to settle for a mere juxtaposition of different topics. This tends to create a bias for one or more components in the course at the cost of other disciplines. This intractable problem is caused by the irrational insistence of different departments to keep increasing their inputs to the course. In most medical schools world wide, the role of a course director is to plan and organize a given course in an unbiased manner. However, more often than not at the SQU College of Medicine the function of a 'course coordinator' (director) has been reduced to a mere timetabler, leaving very little scope for developing a truly integrated course. There are some general problems that are ubiquitous and are encountered in any and every course to a lesser or greater extent. Northway and Paul have described such problems in considerable detail.[7] Language can be a major problem, despite the intensive training in English that the students receive during the first 2 years. Since the language of instruction is English, the recommended textbooks and additional workbooks are in English. Fluency in the English language varies from student to student, and the lack of both basic and scientific vocabulary is often evident. Studies from the Faculty of Medicine and Health Sciences, United Arab Emirates University have demonstrated that English language proficiency and academic performance of medical students are closely linked. It has also been reported that not only language proficiency but also predominant social and cultural factors contribute to learning in the Middle East.[8,9] Also, sometimes the teacher speaks no Arabic (lingua franca), so a breakdown in communication is not uncommon. Effective learning can only be possible by understanding the background and educational needs of a student community. Basic learning skills that are meaningful may also be lacking. Indeed, most students memorize vast quantities of information, which is regurgitated at the time of the examination and then forgotten. This happens for 2 main reasons. Firstly, this is the way our students have been trained to learn from their high schools. They find that memorizing gives them a better chance to obtain superior grades. Secondly, students simply concentrate on passing the final examination without bothering to comprehend basic concepts. The majority of students do not seem to graduate from the stage of "knowing" to the stage of 'understanding.' It has been demonstrated that a study-skill course helps new medical students in bridging the gap between the teacher-centered traditional system of schooling and student-centered PBL curriculum.[10]

One of the major problems that we are facing is that because of the relative weighting of different components of the course, students tend to ignore subjects that contribute less credit hours. For example in the HNS course far too much emphasis is laid on structure (52% of the total), while physiology contributes 37% and pharmacology only 11% of the total credit hours. The students, thus, often neglect pharmacology, which makes for a smaller part of the overall course. To augment the input of pharmacology in the CNS and special senses course by increasing didactic lectures, would be an obsolete idea. Our students tend to find pharmacology a dry subject and this idea is reflected in their attitude towards the learning of pharmacology throughout their MD program. Hands on training of pharmacology is somewhat limited during the preclinical years. Although our students are now being exposed to case based and computer-assisted learning of pharmacology, most of their learning is still centered on lectures. Ways of overcoming this problem have been addressed in the changes proposed for the future.

Changes proposed for the future. An explosion in scientific knowledge and the introduction of newer diagnostic and patient monitoring techniques is forcing medical educators to explore better and more effective schemes for presenting the core information to medical students. The modern educational trends tend to vary from one institution to another in their approach as well as contents. However, there appears to be some pedagogical consensus emerging on the following issues: 1. Emphasis on conceptual learning at the expense of details-oriented education. 2. Amplification of an integrated approach as opposed to subject based instruction. 3. Student-centered, PBL in small groups with stress on critical thinking.[11]

In the last 25 years, the medical curriculum has been steadily shifting towards a PBL curriculum. Barrows Taxonomy assumes PBL as a broad-based educational system that unites distinct denominators. The educational objectives stated are development of clinical reasoning, self-directed learning skills and to structure knowledge for use in clinical context.[12] The essential features of PBL have also been extensively discussed by others.[13] In the Middle East, PBL of different hues has already been implemented in the Arabian Gulf University of Bahrain[14] and in the Faculty of Medicine and Health Sciences in the University of United Arab Emirates (UAE).[9] Mpofu et al of Al-Ain, UAE have warmed that in PBL it is crucial to select effective problems in facilitating students to identify relevant learning themes otherwise the efficacy of PBL is compromised.[15] More recently, Al-Gindan et al in Saudi Arabia have also raised the issues of reforms in the undergraduate medical curriculum. They have argued to bring medical education more in line with the changing emphasis on community-based, integrated teaching with the stress on self-learning and critical thinking rather than the traditional way of imparting medical knowledge.[16]

The interdependence between the content and learning program is fundamental to the philosophy of self-directed learning in the PBL paradigm and are inextricably linked to the degree of freedom that students are allowed to pursue in their inquiries. Keeping these principles in mind, we wish to modify the content of the CNS and special senses course (which is too long), despite the fact that the present course has been voted twice the best course (by the students) in the College of Medicine. It is our intention to reduce the total number of lectures by more than 25% in the first instance. We also want to increase the total number of clinical cases that will be presented at appropriate times during the course. Indeed, attempts will be made each week to coordinate and integrate the subject matter presented in lectures, tutorials, practicals and clinical cases. The problems posed by the integration of various disciplines like anatomy, physiology and pharmacology and so forth, though not highlighted in Barrows' taxonomy do pose a great challenge in real practice. The more successful PBL programs emphasize the importance of proper multidisciplinary integration. Pharmacology needs to be taught in a more imaginative manner and new methods of integrating pharmacology into a PBL curriculum have been suggested.[17] Their approach has resulted in the avoidance of information overload in pharmacology, better retention of knowledge and improved overall performance coupled with a positive and enjoyable learning experience.[17]

In the future, we aim to incorporate new ideas in the teaching of pharmacology that are in congruence with currently emerging educational trends, such as drug-patient and disease oriented concepts.[18] Traditionally, lectures impart each aspect of scientific knowledge in distinct perspective, rather than presenting a holistic medical viewpoint. Also such knowledge acquired by the student usually is forgotten by the time the student reaches the clinical years.

In addition, an independent study of the latest important discoveries will be encouraged as part of a self-learning exercise. We also want to introduce more pathology in the course. It is our intention to redesign the course in such a way that encourages medical students to look at the brain in a new way, a way that unites its biological and social dimensions.[4] A continuum from neuron to behavior; where neuroscience seamlessly integrates with psychology. These curricular changes will necessitate concomitant changes in assessment methods, better cooperation between different departments and more involvement of the course coordinator in designing appropriate examinations. Examination formats need to be changed and one way would be to truly integrate MCQs, essay questions and case presentations with other related basic medical sciences.

In order to strike a balance between content and process one has to be careful not to unduly compromise one for the other.[14] Though student autonomy is the kernel issue in student-centered learning in PBL, nonetheless the importance of the learning agenda as defined by the faculty should not be over looked. For instance a healthy combination of faculty-facilitated content driven and student-centered process oriented curriculum would be something to look for. This would fulfill both the criterion of directive tutoring with process-oriented self-learning. In literature there are some suggestions to organize internationally accepted PBL curricula and database that can possibly serve as an archetype for other traditional medical schools.[14,19] Creating such a database for the purpose of learning from other's experiences would certainly be a good concept. However, using that as a template to replicate the system may not be such a grand idea. We understand that it would be a grave error of judgment to imitate the Harvard or McMaster model of PBL curriculum. Some PBL enthusiasts do argue to follow the western model of PBL without realizing the differences between the 2 educational traditions of the occident and the orient.[14] Specially, when one considers the 3-major differences between the North American and Eastern educational scenario. First, the schooling in North America is very different from the schooling in this part of the world. There the emphasis is laid on understanding and self-learning while here we advertently or inadvertently stress on memorization of factual information. Secondly, in North America students join medical school after finishing their first degree, not after high school (as is the case here). Thirdly, PBL is a human resource intensive program that requires a large number of well-trained tutors to organize small group learning tutorials and case discussions. It would be prudent on our part to keep in

mind the differences in the educational, socio-cultural background and available human resources while designing a new course. We are working to evolve an eastern version of PBL that suits our local needs, resources and international standards. Lloyd-Jones et al have also stated that "PBL in action is not a unity, but, rather an institutional educational system that each school should develop according to its own requirements, objectives and resources".[13] We believe that PBL in action is a behavioral attitude-skill paradigm that is inculcated among students during various stages of their schooling. It is a mind-set that motivates students to question, critically examine and reason out things and not to merely embrace facts as described by a teacher. Probably such an approach also gets reflected in day to day dealings in life. There is a saying that "old habits die-hard" and furthermore deeply entrenched socio-cultural dogmas retard such developments even further. However, this does not preclude us from developing a critical mental attitude later on in life. As shown by Huda and Brula, new medical students coming from a traditional schooling system can be trained to acquire 'learning skills' required for PBL.[10] Nevertheless, this approach is not an ultimate paradigm, etched in stone, but a continuously developing system that should evolve with the changing socio-educational scenario in this part of the world.

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