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Body and Disease 2008: An Integrated Course Teaching Pathology, Pharmacology, Immunology and Microbiology

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ABSTRACT

The Duke-NUS Graduate Medical School Singapore (Duke-NUS) Body and Disease course is a 20-week, integrated course occurring at the end of the first year. The course covers four basic science topics: Pathology, Pharmacology, Immunology, and Microbiology and is modelled after the same course from the Duke University School of Medicine (DSOM) in Durham, North Carolina, USA. The structure of the course, as delivered by DSOM, was adapted to meet the needs and structure of the Duke-NUS programme. In addition, the course was adapted significantly to incorporate the Team-Based Learning methodology. In this paper, we detail how we approached these unique challenges. This paper presents an overview of the course structure, preliminary evaluation, and implications for future implementation.

Keywords: course development, medical education, small-groups learning

INTRODUCTION

Duke-NUS Graduate Medical School Singapore began in 2007 with its inaugural class of 26 students. This is one of a series of presentations on the innovations in the curriculum and course structure^{1,2}.

Body and Disease is a 20-week course delivered in the second half of the first year of the Duke-NUS Graduate Medical School Singapore (Duke-NUS). The curriculum and course objectives are the same as those of the corresponding course that occurs at the Duke University School of Medicine (DSOM) in Durham, North Carolina, USA. The intention was to use the source materials from DSOM, minimise lecturing, drive the principle of individual responsibility for self-directed learning, emphasise key principles rather than attempt to cover all the

factual materials, and finally to make Team-Based Learning³ a key educational strategy.

An adaption of Team-Based Learning (which we call TeamLEAD) is implemented extensively during the first year of the Duke-NUS programme. There are several distinct phases in any TeamLEAD session. They include the independent review of the materials by the student, the Readiness Assessment Tests (RAT), the Application Exercise (AE), the facilitated discussion, and the peer evaluation.

The RAT is a Multiple Choice Question (MCQ) style test divided into 2 phases, Individual (IRAT) and Team (GRAT), with both components contributing to the final grade. At the start of each TeamLEAD session, the students are given a test to complete

individually (closed book). Once the IRAT is complete, students take the same test as a team, coming to a consensus on the correct answer. Their answers are recorded on an Immediate Feedback Assessment Technique (IF-AT) form⁴, where they know immediately if they got the correct answer or not. They continue selecting until they get the correct answers. At the end of this session, the faculty knows what concepts students individually and as a team did not understand. A brief review of those core concepts are done at this point. This enables the students to be prepared for the application exercise (AE).

The AE session is open book and open internet, during which the students are assigned problems and questions to solve within their team. The AE marks also contribute to the final grade. These problems are usually complex and challenging, and emphasise the application of the basic science principles to solving problem in a clinical setting. The answers from the AE are reported simultaneously and this is followed by a facilitated discussion on the answers chosen to solve the problem and the rationale behind the choice. Students are expected to defend their choices, and deal with further issues brought up by the facilitator.

THE CURRICULUM

The DSOM Course

At DSOM, the same course has been modified over the years to become an integrated, multi-disciplinary 20-week approach to Pathology, Pharmacology, Immunology and Microbiology. The delivery of the course involves 217 hours of lectures, 118 hours of small groups teaching and laboratory sessions. In addition, there are 64 hours of clinical workshops during which a number of medical and para-medical staff present a problem or a patient, followed by a lecture on the topic at hand. The students are given 10 exams, occurring every 2 weeks, with no end-of-course exam. TeamLEAD is not part of their course. During the first 7 weeks, students are taught the basic principles of the 4 sciences, and in the latter portion of the course, teaching revolves around a specific organ system each week or fortnight.

The Duke-NUS Course

In 2007–08, our course followed much of the structure and content of the DSOM course, specifically the 2-week modular structure with regular end-of-module exams (giving a total of 10 exams), as well as the general division between general principles at the beginning and an organ-specific emphasis in the latter section. We also used the lectures delivered at

DSOM for this course as the primary source of core content materials. Duke-NUS has access to archived videos of all lectures delivered at DSOM, as well as the relevant slides and student handouts. The archived lectures, thus, became the preparatory materials for the TeamLEAD sessions and the source of information for the creation of the end-of-module exams. These materials were made available to the students via an individual hard disk drive, together with a schedule detailing which lectures were to be reviewed for each learning event within the 20 weeks.

After analysing the volume of preparatory materials, and the time available, we decided that within each 2-week module, there would be 3 TeamLEAD sessions and 1 end-of-module exam. This meant that over 20 weeks we delivered 30 TeamLEAD sessions.

The TeamLEAD sessions were integrated where only a minority were focused on issues from a single science, whereas most had questions and preparatory materials from several (or all) of the 4 disciplines in the course. Likewise, the exams required the students to review all the materials from all 4 disciplines for that module.

In contrast to the DSOM recorded lectures as a source of primary materials, the laboratory sessions from DSOM were replicated and delivered “live” here in Singapore to give the students the benefit of the hands-on practical approach to the materials, as well as to teach them the relevant practical skills. The volume of materials that was delivered in the science-specific laboratories required that we conduct 38 sessions for pathology, 6 for Pharmacology, 12 for microbiology and 4 for immunology.

In addition, the course had 8 half-day workshops where invited speakers talked about a single subject that highlighted the multidisciplinary approach that is vital to the progress in medicine today, or a subject where there was considerable local expertise and the disease was of significant interest to local practitioners. These sessions were the only component of the course to not have any contribution to the final grade.

Development of TeamLEAD sessions

Conventionally each TeamLEAD session is seen as a single self-contained unit, with the preparatory materials, the RAT, and the application exercises mapping directly to each other in terms of the content and learning objectives. In addition, for other first

year Duke-NUS courses, usually a single content expert was assigned a single TeamLEAD session and developed all the questions (RAT and Application). We chose a more team-based collaborative approach. Firstly, given the volume of materials, we wanted to ensure there was adequate breadth of coverage in terms of the RAT/exam questions, and this required a relatively small group of faculty to take responsibility for that portion of the course. Secondly, given the nature of the subjects, the appropriate and interesting application exercises were largely clinical in nature, we had to ensure an appropriate coverage of basic science questions in the RAT and exams. However, the primarily science-based course faculty were not as confident in developing clinically driven application questions. Thirdly, we wanted to ensure the sessions were developed with a clear understanding of where along the course the students were, with respect to the level of difficulty and also to avoid repetition. Finally, we wanted to take the opportunity to introduce the students to the challenge of developing clinical analytic skills to drive an understanding of differential diagnosis, appropriate investigations, interpretation of laboratory data, and choice of treatment; this required the application questions to be developed longitudinally along the course, rather than looking at each session in isolation.

Thus, we decided that the RAT and exam questions reflect the “Core Knowledge” expected of the students, and be almost exclusively developed by the course director and co-directors themselves, ensuring adequate representation of the breadth of basic sciences, and an approach and level of difficulty consistent with the relevant point in the course, as well as taking into account the learning that occurred in the laboratory sessions (which were conducted by the course director and/or co-directors). This also meant that the course directors took responsibility for all the relevant core course materials to ensure that it was all reflected appropriately in the course.

The Application Exercises represents our “Stretch Curriculum” where we ask the students to apply their basic science knowledge and expose them to a variety of problems and issues to challenge and interest them. Clinical Experts (CEs) were then invited to participate in these sessions that covered their own particular area of interest, and were asked to prepare a short presentation on the clinical issues to be delivered at the end of the session.

The CEs were invited to submit application questions on the subject matter after a briefing of the requirements of the TeamLEAD methodology by one of the course faculty. The questions were then reviewed by several of the course faculty, together with the CE, and adapted as needed. The process culminated in the TWIP (TeamLEAD Works In Progress) session that is a standardised part of the Year One curriculum development process at the Duke-NUS. In a TWIP session, course faculty and the CE present the questions to a team of peers who were not involved in developing the questions. The session focuses on the appropriateness of the questions and the level of difficulty, as well as emphasising the principles of good question writing. On many occasions, the ability of a pair of unbiased eyes and a fresh mind to significantly improve a question or problem was of considerable value.

TeamLEAD sessions

The TeamLEAD sessions begin with the IRAT. These are typically MCQs, with the answers submitted using the “clicker” technology, over a wireless network. At this point, the students do not have feedback on which are the correct answers. The next phase is the GRAT. In this portion, students receive instant feedback each time they commit the team to an answer, and if incorrect they can attempt the question again for less marks. At the end of the RAT, the faculty have all the marks from the IRAT and GRAT, broken down by student and by team instantly available. This enables the faculty to focus further discussion only on those areas that were most important and where a significant number of students had erred. The next portion is the AE. This generally involved a fixed block of time, with each team working their way through the questions at their own pace, committing to answers without any instant feedback.

In parallel, while the students were busy with the AE, the course faculty, the facilitator and the CE were in a separate room. We worked through the AE, planning for the discussion and facilitation session ahead. Our focus was divided into 3 main areas:

1. What is the key learning point to emphasise?
2. How do we generate further discussions if the whole class got this one right? and
3. What further questions or points of interest can be brought up?

The reason for this discussion was that we felt that the debate and discussion around the answers was a key process in driving the understanding and retention of the materials. In the discussion, it was assumed that for each question a team would be called upon to defend their answer and explain to their peers why they chose it.

Once the students completed the AE, or the preset time had been reached, the discussion began. The facilitator then drove the discussion and debate, calling upon the students to defend their answers, to address each others' concerns and questions and occasionally to field follow-up questions. At relevant points, the facilitator called upon the faculty or the CE at the back of the class to comment on the statements so far, and to sum up their (definitive) opinion on the question(s) at hand.

At the end of the discussion, the CE then delivered a short presentation on the underlying topic, which lasted no more than 30 minutes.

Exams and Individual Subject Labs

The end-of-module exams were structured exactly the same way as the RAT portion of the TeamLEAD sessions. The main difference on the end of module exam from a typical RAT session is that the number of questions is greater (50 instead of 10). Unlike a typical exam where feedback is seldom obtained, students continue to complete the exam as a GRAT so that students continue to learn after their individual submission of answers.

The microbiology laboratories follow a structure similar to many other courses, with the students working in small facilitated teams to perform a series of technical tasks and correlate their findings with their scientific knowledge. Each session is preceded or finished by a short didactic presentation on the topic.

In pathology laboratories, students are assigned preparatory materials in the form of digitised histopathological slides, which they study with the aid of a syllabus individually prior to the session. They are then given time in class to address the questions as a team, followed by a lecture and an interactive tutorial on the subject, using virtual microscopy system (Bacus Laboratories Inc).

The immunology and pharmacology laboratories are essentially structured and focused tutorials, conducted by a single faculty expert on the subject.

All labs and tutorials have assigned preparatory reading materials, and many have questions, with the marks counting towards some portion of the final grade. During the development of the course, many methods of testing and questioning were attempted. The most successful combination was found to be some form of IRAT followed by some form of GRAT. We defined success in these sessions to mean a strategy that drove the students to adequately prepare the materials individually, that leveraged on the team-learning process with the students teaching each other, and resulting in a challenging, yet enjoyable time for faculty and students.

PROGRAMME EVALUATION

Methods

Two weeks before the end of the course and before the students knew their final grades, we administered a survey to all first year medical students (n=26) in 2007–08 academic year. The purpose of this survey was to assess student's perceptions on the impact of this course. The survey contained 14 items and students rated each item on a 1–5 likert-type scale (1=Strongly Disagree/poor, 5=Strongly Agree/outstanding).

Results

Twenty-four (92%) students completed the survey. All students passed the course (70% or higher was passing) with ten receiving honours (90% or higher). Table 1 provides the results from the survey. The highest rated items were questions 13, 4, 6, 14, 2 and 3.

Discussion

Social Engineering and Behaviour Modification

Faced with excellent preparatory materials, a clear understanding of what was expected and the certainty that they would be tested, the student body consistently drove their own learning. Further, by minimising our (the faculty's) willingness to discuss every negative distractor we saw a greater emphasis on team work and team learning.

We were repeatedly faced with the students' difficulty in dealing with ambiguity and uncertainty in medicine. They always wanted to know which was the "right" answer. More and more questions were then developed in which there was more than 1 correct answer, and this would be emphasised in the discussion. In addition, we took pains to point out the differences in opinion within the faculty or CEs present. In parallel, we had to make clear that the reasoning behind the choice of answer was almost as important and the citation of a reference alone was never

Table 1. Mean scores from End of Course Survey (n=24).

	Items*	Mean (SD)
Q1	I am confident that I have mastered the material presented in the course to the level expected by the faculty.	3.46 (0.72)
Q2	I believe that I have mastered the B&D material to a greater degree than I might have in another program as a result of the TeamLEAD approach.	3.88 (0.85)
Q3	I believe that I have mastered the first year material to a greater degree than I might have in another program as a result of the TeamLEAD approach.	3.83 (0.87)
Q4	TeamLEAD is a fun way to learn the material.	4.25 (0.79)
Q5	TeamLEAD made the learning environment less stressful.	3.25 (1.19)
Q6	My team played an important role in helping me achieve my best.	4.17 (1.05)
Q7	I would rather have the TeamLEAD than the lecture format that Duke-Durham has.	3.75 (1.15)
Q8	Compared to other MBBS medical students I know, I believe our class is better prepared for the clinical wards.	3.54 (0.72)
Q9	I personally feel ready for the clinical wards.	2.79 (1.02)
Q10	The class as a whole has mastered the basic science material to a greater degree than that expected of an average group of first year medical students in an MBBS program.	3.75 (0.74)
Q11	I believe I am now thinking like a doctor.	3.71 (0.75)
Q12#	If you do believe you are now thinking like a physician, when during the B&D course do you believe it happened?	3.88 (0.74)
Q13 *	How do you rate the learning experience of Body and Disease?	4.38 (0.58)
Q14 *	How would you rate the learning experience of the first year?	3.96 (0.69)

All items were rated on a scale of 1=strongly disagree, 5=strongly agree except those noted with hash and asterisk. Q12 with hash (#) was rated on scale 1=beginning and 5=end while those with asterisk () were rated on scale of 1=poor, 5=outstanding.

enough. The students were expected to explain why they agreed with their source. This was especially important given the open internet accessibility for the AE, and the large amount of materials easily available, not all of which is quality assured.

Another aspect of the course that drove learning behaviour is the Appeal Process. Teams (not individual students) could challenge the “correct” answer to a question by submitting an appeal. In order to win the appeal, the team had to provide a cogent argument as to why their answer could be correct and/or how the ambiguity of the question led to a different response. For the latter rational, we requested students to provide

a better phrasing of the question to get at the same learning point. The beauty of the Appeal Process is that it provides possible better questions for the faculty and engages the students in critical and persuasive debate skills. Rarely do students go back and review exam concepts in a typical learning environment. This system facilitates review and critical thinking of concepts.

In addition, based on the results of the end of course survey, students appeared to be pleased with the experience. They not only had fun, and felt their teams were important in their learning, but thought that this helped them begin to think like a doctor, and compared to other courses they have had in the past

(at Duke-NUS or elsewhere), the majority of the students rated their experience as a 4 or 5.

Limitations

We recognise that this is a small sample size, of very dedicated students, and a self-reported survey. In addition, the real impact of this course along with the entire framework of the Duke-NUS programme will be demonstrated as they move into the clinical arena and begin to take the standardised exams; however, we were very pleased with the preliminary results that encouraged us in the use of these techniques.

FUTURE DIRECTIONS

As this article is being written, we are in the midst of planning the course for next year. What changes will we make in response to what we have learned? We detail the most striking changes.

There will no longer be any end-of-module exams. Instead, the number of TeamLEAD sessions will be increased to 40, 2 per week, to generate a “steady-state” of testing, with no session having greater emphasis on the marks. The total number of MCQs per week increases to 50 (from 40).

We will extend the philosophical divide between the RAT and AE, by separating them into distinct sessions. In addition, we are adding a modification

to the original TeamLEAD process, by allowing each team to choose 2 of the 25 questions in the RAT to do as open book. The answers for these questions will be reported in a similar fashion to the AE, but without the discussion. We hope that by incorporating this small change the students will be further driven to take on responsibility for their own learning, and if that is inadequate to see their team as their first resource, the class as the next, and the faculty as the last.

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