Student perspectives of assessment by TEMM model in physiology

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Submitted 23 September 2004; accepted in final form 3 January 2005

Assessment seems to be the most important factor that drives student learning (1, 2, 13, 15). Students usually learn only the material on which they are assessed. They do not go beyond the learning issues. If a test requires memorization of facts, they are driven to do that. This will lead to a situation where they adopt a surface approach to learning. Research shows that the type of assessment method adopted can influence student learning (5). If the assessment pattern consists of a variety of methods that demand understanding of the subject matter, this problem can be solved to some extent.

To test the earlier observation that a single exam does not fulfill all the functions of assessment, such as assessing knowledge, comprehension and skills, motivation, and providing feedback (10–12), we developed an evaluation system that motivated and provided feedback to our students and at the same time rewarded excellence. In this paper, we describe assessment systems should aim at evaluating the desired learning outcomes. In Melaka Manipal Medical College, (Manipal Campus), Manipal, India, the TEMM model (consisting of 4 assessment methods: Triple Jump Test, essay incorporating critical thinking questions, Multistation Integrated Practical Examination, and multiple choice questions) was introduced to 30 refresher students in the fourth block of the academic year. At the end of the block, a questionnaire was distributed to ask the students to rank the different assessments in the order of their preference with respect to seven items. Analysis of the results showed that not a single type of assessment was ranked highest for all the seven items, proving the earlier observation that a single assessment does not fulfill all aspects of assessment and that there is a need for an evaluating system with multiple ways of assessment.

EDUCATIONAL CONTEXT

The undergraduate medical program at Melaka Manipal Medical College (MMMC), (Manipal Campus), Manipal, India, is a 5-yr, intensive academic program. The language of instruction is English. Physiology is taught during the first year, integrating with other subjects namely, anatomy and biochemistry. Students learn general, systemic, and applied physiology by didactic lectures and practical, self-directed learning sessions. In MMC, the physiology curriculum is divided into four blocks.

**Block 1.** Basic concepts and blood, nerve, and muscle physiology.

**Block 2.** Cardiovascular, respiratory, and gastrointestinal physiology.

**Block 3.** Endocrine, reproductive, and renal physiology.

**Block 4.** Central nervous system and special senses.

**METHODS**

The TEMM model was incorporated as the assessment tool for 30 refresher students in the entire fourth block of the 2002 academic year. Refresher students are those who were unsuccessful in their final examination in the first chance and therefore were made to repeat the training again for a period of 6 mo. Their class was small (n = 30). The first three blocks were taught to them in the traditional method, consisting of didactic lectures and practical sessions.

**Triple Jump Test**

The Triple Jump Test consisted of three steps.

**Step 1.** A set of topics on which students were to be assessed were announced in the beginning of the fourth block.

**Step 2.** During each session, some time was allotted to the students (depending on the content) to refer to their resource materials. Each student was required to present a subtopic in the topic on which they were assessed. The students were allowed to discuss among themselves and also with the faculty to create group dynamics.

**Step 3.** After the presentation, students were assessed on that topic. Students were administered a test of 30-min duration. The test paper consisted of objective-type test forms, for example, short-answer questions, fill in the blanks, true/false, matching items, and restricted response essays.

**Essay Incorporating Critical Thinking Questions and Case Studies**

At the end of the block, students wrote a 2-h essay examination for 50 points. The essay consisted of Critical Thinking Questions (CTQ) for 11 points (questions which required the students to give a basis for some physiological concepts) and case studies for 15 points. Short-answer questions contributed to the remaining 24 points.

**Multistation Integrated Practical Examination.** Students were assessed on their skills, comprehension, and competence in practical exercises in the block examination. The practical examination consisted of two components: performance exer-
cises and Objective Structured Practical Examination (OSPE). In the performance examination, students were given two exercises: one major experiment, (e.g., clinical examination of reflexes) and one minor experiment (e.g., determination of vital capacity). The performance exercises were classified into major and minor exercises based on the content and time required to perform that exercise. Students were required to perform these exercises in the presence of the examiner. In OSPE, students are made to rotate through 10 stations and undertook a variety of tasks, such as interpretation of graphs, diagnosis of clinical conditions from photographs, identification of blood cells through a microscope, reading packed cell volume/erythrocyte sedimentation rate, calculation of clearance/forced expiratory volume in 1 s, etc. Each of these stations had questions carrying four points. Some stations included questions that emphasized the clinical relevance of basic physiology teaching.

Multiple Choice Questions

In addition to the essay, students had to appear for a 1-h multiple choice question examination at the end of the block, which again included questions that demanded understanding of the subject matter in the form of true/false questions. At the end of the exam, the answer key to the questions was provided to the students, and any feedback regarding the questions and answers were invited. This provided an opportunity for the students for learning and for the faculty for modifying the question format to improve relevance and comprehension of questions in the succeeding exams.

At the end of the block, students were given a questionnaire containing three parts. The first part was an open-ended question regarding whether they liked to be assessed by one type of assessment or more than one type. The second part was to state the reason for their response (see Table 1). The third part was to rank the different assessment methods with respect to seven items from highest to lowest (1, highest; 2, high; 3, low; 4, lowest) (see Table 2). The items are as follows: provides motivation, creates stress, tests more of understanding than memorization, tests more of memorization than understanding, application of knowledge in clinical practice later, emphasizes the relevance of subject matter, and provides feedback. *Ranks* 1 and 2 (highest and high) were considered as higher ranks and *ranks* 3 and 4 (low and lowest) as lower ranks for analysis. Therefore, the number of students who marked *ranks* 1 and 2 were added together to get the higher rank. Similarly, *ranks* 3 and 4 were added together to get the lower rank. For each item in Table 2, if the sum of *ranks* 1 and 2 is greater than that of *ranks* 3 and 4, the numbers are shown in bold to indicate that the larger number of students had marked a higher rank for that item. The responses to the questionnaire are shown in Table 2.

**RESULTS**

Out of the 30 students, 27 returned the filled-in questionnaire. A few of the reasons given by the students for their preferences are shown in Table 1. Twenty-six students reported that they liked to be assessed by more than one type of assessment in response to the first question.

As shown in Table 2, the Triple Jump Test (Fig. 1) was rated high for *items* 1 and 7. The essay incorporating CTQ and case studies was ranked high for all items (Fig. 2). The Multistation Integrated Practical Examination (Fig. 3) was ranked high for *items* 3 and 5-7. Regarding multiple choice questions, the majority of students ranked *item* 4 alone as high (Fig. 4).

Table 1. *Reasons given by the students (n = 27) for performing multiple methods of assessment*

<table>
<thead>
<tr>
<th>Item</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides motivation</td>
<td>7</td>
</tr>
<tr>
<td>Creates stress</td>
<td>8</td>
</tr>
<tr>
<td>Tests more of understanding than memory</td>
<td>2</td>
</tr>
<tr>
<td>Tests more of memorization than understanding</td>
<td>7</td>
</tr>
<tr>
<td>Application of knowledge in clinical practice later</td>
<td>2</td>
</tr>
<tr>
<td>Emphasizes the relevance of subject matter</td>
<td>6</td>
</tr>
<tr>
<td>Provides feedback</td>
<td>10</td>
</tr>
</tbody>
</table>

**Table 2. Rankings of the questionnaire items related to each component of the evaluation system**

<table>
<thead>
<tr>
<th>Type of Assessment</th>
<th>Triple Jump Test</th>
<th>Essay Incorporating CTQ and Case Studies</th>
<th>Multistation Integrated Practical Examination</th>
<th>Multiple Choice Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Provides motivation</td>
<td>7</td>
<td>12</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Creates stress</td>
<td>8</td>
<td>3</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Tests more of understanding than memory</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Tests more of memorization than understanding</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Application of knowledge in clinical practice later</td>
<td>2</td>
<td>5</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Emphasizes the relevance of subject matter</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Provides feedback</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Values are rankings of items from the questionnaire by 27 students. Students ranked 7 items by: 1, highest; 2, high; 3, low; and 4, lowest. The number of students who marked *ranks* 1 and 2 were added together to get the higher rank and the number of students marking *ranks* 3 and 4 were added together to get the lower rank. Numbers in bold indicate that the larger number of students marked a higher rank for that item.
DISCUSSION

In this study, we tried to evaluate student perspectives on assessments in physiology. Assessments have the potential to motivate and influence learning approaches of students (5, 16). As shown in Table 2 the Triple Jump Test scored the highest ranking for providing motivation and feedback. The majority of students also felt that this creates less stress. The essay incorporating CTQ and case studies was ranked highest for being the assessment type which provides motivation, tests more of understanding than memorization, and tests for ensuring the relevance of subject matter. The highest ranking for motivation could be due to less content of the topic and group interactions that were found to be factors associated with assessment that influences student motivation (15). This correlates with the earlier observation that intrinsic motivation is created when the relevance of the subject matter is the primary driving force (15, 16). The essay incorporating CTQ and case studies is a type of modified essay question that tests higher cognitive levels of knowledge. It has been found to be a reliable method for assessing problem solving skills (5, 9).

The Multistation Integrated Practical Examination was ranked high by the majority of students for items 3, 5, and 6. This type of assessment serves as a tool for testing multiple dimensions of student performance because it tests both skills (as in performance exercises) and knowledge (as in OSPE) (7, 8). The majority of students had the opinion that multiple choice questions were less stressful and tests more memorization than understanding of the subject. Our findings correlate with the earlier findings that multiple choice questions test more of factual recall (3, 6). Nevertheless, if framed properly, multiple choice questions could be used to assess different levels of intellectuality (4). Our results agree with the earlier findings that a single type of assessment alone does not meet all the criteria for evaluating student performance (10, 12).

In conclusion, we have outlined the features of the evaluation system followed in our setup, and based on the feedback, we consider that it would help students to develop different learning skills and make them better learners. It also helps teachers to think about innovative methods of teaching and evaluation to improve the relevance of physiology in clinical practice and to modify question format to improve relevance and comprehension of questions in the succeeding exams.
REFERENCES

9. Knox JDE. The modified essay question, booklet no. 5. Edinburgh, Scotland: Association for the Study of Medical Education.