Evaluation of Basic Medical Sciences Knowledge Retention Among Medical Students

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Abstract
Introduction: Recall and understanding of basic science knowledge is considered background for studying the clinical sciences but does not directly affect clinical knowledge. Our aim was to evaluate the basic medical sciences recall and explore the association between the knowledge of basic and clinical sciences concepts. Methods: The current descriptive study was conducted during the academic year 2009-10. It included 183 medical students (48.6% male, 51.4% female) from among 2nd, 3rd, 4th and 5th year students of Taibah University College of Medicine in AL-Madinah AL-Munawrah, Kingdom of Saudi Arabia. Response rate was 73%. We administered an anonymous knowledge test with 15 basic and clinical pairs of questions. Results: There was a statistical significant overall effect of the study year when the second basic year students score compared with the clinical year’s scores for basic questions (6.4 ±1.9 and 5.68 ±1.7, F = 12.51, p<0.001) and for clinical questions (4.0 ± 2.5 and 4.5 ± 1.8, F = 14.73, p<0.001) respectively. Conclusions: We would recommend modification of basic knowledge education to correlate with clinical training such that the student would be able to assimilate concepts of disease at an integrative level.

Introduction
Medical students build their clinical knowledge on the grounds of previously obtained basic knowledge. Nevertheless, many senior undergraduate students indicate informally that their memory of basic science medical courses is less than expected, and the content of those courses did not seem relevant to their later clinical work or studies (1). A significant correlation between the knowledge of basic
and clinical medical facts by students of pre-clinical and clinical medical studies, may be due to the facts that successful students answered both sets of questions more accurately in general regardless of the causative relationship between basic and clinical knowledge (6). Prior studies indicate that performance of medical and dental students on written tests generally declined over time. This probably varies with ongoing reinforcement and quality of initial learning, (7) and indicates that strong long-term memory is associated with aggressive individual learning habits in the initial phase as well as the spacing of instruction over time.

The College of Medicine at Taibah University was established in 2001, with a traditional medical school curriculum. However, the curriculum and methods of teaching has always been the subject of investigation and evaluation. The college has had strong intentions to modify the current curriculum, so it was deemed essential to look for specific scientific evidence.

The clinical concepts were expected to be familiar to 2nd year students, since they were learning examples of applied basic science in medicine in the preparatory year as well as second year courses.

The current study is designed to explore the level of basic knowledge of physiology, and biochemistry and its influence on the level of clinical knowledge concepts among 2nd, 3rd, 4th and 5th year medical students. Comparison of basic medical knowledge between 2nd, 3rd, 4th, and 5th year medical students illustrates whether basic science concepts are retained at the 3rd, 4th, and 5th year of medical studies. This can ascertain if senior students accept clinical knowledge with sufficient insight into causality of processes learned, and explores the degree to which students’ comprehension may deteriorate over time.

Materials and Methods

Settings and Participants
The current study is a descriptive study that included 183 medical students (48.6% male, 51.4% female) from the 2nd, 3rd, 4th, and 5th year students of Taibah University College of Medicine in AL-Madinah AL-Munawarah. Subjects included represent a convenience sample of total students. Participants filled out a brief personal data questionnaire before answering the knowledge test. The second year students, 61 (33.3%) filled out the test in late May and

### Table 1: Characteristics of students involved in the study at the College of Medicine, Taibah University, Kingdom of Saudi Arabia.

*Grade point average (GPA). Grades at the college of medicine range from 2–satisfactory to 5–outstanding to the year of 2009, when the students filled out the test.*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
<th>5th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (Males)</td>
<td>34 (27)</td>
<td>17 (24)</td>
<td>19 (20)</td>
<td>24 (18)</td>
</tr>
<tr>
<td><strong>GPA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥4.1</td>
<td>13 (10)</td>
<td>6 (9)</td>
<td>7 (8)</td>
<td>9 (6)</td>
</tr>
<tr>
<td>3.6-4.0</td>
<td>11 (9)</td>
<td>6 (9)</td>
<td>6 (7)</td>
<td>8 (6)</td>
</tr>
<tr>
<td>≤3.5</td>
<td>10 (8)</td>
<td>5 (6)</td>
<td>6 (5)</td>
<td>7 (6)</td>
</tr>
</tbody>
</table>
early June 2010, after they had completed physiology and biochemistry courses. The 3rd, 4th, 5th year students, 122 (66.7%) completed the test after they had finished their clinical courses in early June 2010 (Table 1).

**Knowledge test**

We developed two sets of 15 open-ended questions. The initial part of the test consisted of questions about basic science, and the second section examined related clinical facts. The order of questions was random, so that it would be less obvious that they formed 15 pairs. We created the questions according to standard textbooks of physiology, biochemistry, and internal medicine used at the Taibah University College of Medicine. A test of 30 questions was formed because it covered adequate knowledge for analysis. The time allowed to answer the entire test was 30 minutes.

![Figure 1](image1.png)

**Figure 1:** shows the designed test correct answers mean scores of second, third, fourth, and fifth years students for basic (open columns) and clinical (closed columns) questions

Each question pair represented a single topic. The basic questions were formed in such a way that the correct answer explained the physiological or biochemical background of the clinical question. Finally, there were seven physiology and seven biochemistry as well as one mixed question pairs. Clinical questions were formed in a way that both basic year and clinical year students were equally familiar with them. This was possible because the clinical concepts involved were covered by the biochemistry and physiology textbooks for the second year.

**Statistical analysis**

Statistical procedures were done using Statistical Package for the Social Sciences, version 13.0 for Windows (SPSS Inc., Chicago, IL, USA). Appropriate descriptive and analytic methods were used. Descriptive methods included, mean, standard deviation, frequency, rations, and percentage. Analytical methods included correlation coefficient, ANOVA, and paired t-test. Level of statistical significance was set at $P<0.05$.

**Results**

Among second year students, the mean number of correct answers of 15 questions was $9.7 \pm 3.8$ for basic, and $6 \pm 3.9$ for clinical questions. For third year students, the score was $6.6 \pm 3.4$ for basic, and $8.2 \pm 2.3$ for clinical questions. For fourth year students, the score was $7.6 \pm 2.5$ for basic, and $7.7 \pm 1.1$ for clinical questions. For fifth year students, the score was $6.4 \pm 1.9$ for basic, and $9.5 \pm 3.6$ for clinical questions (Figure 1).

It was found that there was a statistically significant correlation between basic and clinical answers scores positively for second ($R^2 = -0.504$, $P \leq 0.0001$), (Figure 2) and fifth year students ($R^2 = 0.426$, $P \leq 0.0001$) (Figure 3), but there was a negative correlation for third year students ($R^2 = 0.188$, $P \leq 0.005$), (Figure 4), and no statistically significant correlation for fourth years students where ($R^2 = 0.001$, $P \leq 0.819$), (Figure 3). However, with final results reviewed, there was no statistically significant correlation for all students ($R^2 = 0.01$, $P = 0.173$), (Figure 5).

ANOVA was performed to compare students’ scores on basic and clinical sets of questions, as well as to determine
the interaction between the study years. It is found that there was statistically significant effect for the test scores indicating that the second and fifth year students scored better on the basic test, and the fifth year students scored better on the clinical test.

There was a statistically significant overall effect of the study year when we compared second year students’ scores as a representative for the basic years with the clinical years score for basic questions (6.4 ±1.9 and 5.68 ±1.7, F = 12.51, \( P \leq 0.001 \)) and for the clinical questions (4.0 ± 2.5 and 4.5 ± 2.5).

**Figure 2:** Pearson correlation between the clinical and basic questions answers scores among the second year students

**Table 2:** Test correct answers mean scores of second, third, fourth, and fifth years students for basic and clinical questions. *significant \( P \leq 0.005 \), **significant \( P \leq 0.0001 \)

<table>
<thead>
<tr>
<th></th>
<th>Basic questions</th>
<th>Clinical questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2(^{nd}) year</td>
<td>6.49 ± 2.5</td>
<td>4.0 ± 1.9 **</td>
</tr>
<tr>
<td>3(^{rd}) year</td>
<td>4.34 ± 2.28</td>
<td>5.54 ± 1.58 *</td>
</tr>
<tr>
<td>4(^{th}) year</td>
<td>5.12 ± 1.68</td>
<td>5.14 ± 0.77</td>
</tr>
<tr>
<td>5(^{th}) year</td>
<td>4.31 ± 1.28</td>
<td>6.33 ± 2.4 **</td>
</tr>
</tbody>
</table>
Figure 3. Pearson correlation between the clinical and the basic answers scores among the fifth year students

Figure 4. Pearson correlation between the clinical and the basic answers scores among the third year students
However, we found a statistically significant difference in scores, which showed that both third and fifth year students scored lower on basic questions than second year students, but obtained higher scores on clinical questions. There was no statistically significant difference between clinical and basic question scores in fourth year students’ scores (Table 2).

There was no difference in either basic or clinical knowledge between male or female students. We found there was no any statistical differences between and within subjects’ ANOVA according to gender differences: females’ mean scores and the males’ mean scores when comparing basic question scores (5.01 ± 2.48 & 5.10 ± 1.99 respectively and clinical question scores (5.43 ± 2.03 & 5.14 ± 2.03 respectively).

**Discussion**

The topic is very important and the study is original. This subject had not been tackled in Saudi Arabia until now, and is extremely important at a time when administrators are considering changing curricula in many colleges of medicine, and establishing other new areas of study.

The results of the current study imply that clinical knowledge can be acquired without complete understanding of its basic science background. This is supported by our findings that clinical year’s students scored higher on clinical questions, but lower on basic questions than second year students. This finding challenges the idea that basic knowledge has a direct influence on the successful answering to clinical questions because, if this causative relationship existed, we would expect and obtain higher scores of basic knowledge in clinical year’s students.

These current results also imply that in the knowledge acquired about medical topics, clinical facts are not always recalled together with the correlating basic knowledge background, but rather that the two types of knowledge are independently acquired and recalled.

The reason for lower basic knowledge in clinical year’s students may be because clinical textbooks do not provide detailed coverage of basic science background, and primary concepts are generally not required in the exams, so they are gradually forgotten. On the other hand, students of the clinical years are overwhelmed by the numerous scientific facts that need to be memorized, and appear to slowly lose their insight into basic science.

Knowledge loss does not seem to be related to marks on final examinations, the assessment of course quality by students, or even gender differences.

Previous studies indicate that the performance of medical
It is important to point out that strong long-term memory, as previous research has noted, is directly associated with over-learning in the initial phase and the proper distributing and renewal of study matter over longer intervals of time (17).

Previous research also found that the focus on meaning and understanding rather than memorization, along with adequate time to learn, especially complex material, and deliberate effective engagement with the task (practice). This means that cramming is counter-productive in the long run, although in the short-term it may produce higher grades on examinations (9).

Conway (10) confirmed identified factors in long-term retention of information at the post-secondary level: taking successive courses (reinforcement), initial ‘active’ learning (though not necessarily high marks on courses), and the nature of the material (procedural over declarative and general over specific). Evidently, the initial learning is not sufficient for long-term retention but it is certainly necessary for iThe importance of the characteristics of practice and reinforcement include distributed, expanding, elaborative rehearsal of information centered on recall. It does not call for recognition or re-presentation of content. Since both initial learning and spaced practice are necessary for long-term memory, knowledge loss cannot be attributed solely to the weakness of course content, but must be shared with the program deficiency that knowledge is not reinforced over time (12-14). Therefore, the well-organized curriculum can facilitate review and aggressive individual learning habits of key concepts as more advanced courses and clinical experiences explicitly and intentionally will use and build on previous learning.

Although some studies of clinical reasoning showed little evidence that clinicians used basic science in routine diagnosis (15), it was also noted that knowledge of basic science may have value in clinical diagnosis by helping students recall or reconstruct the relationship between features and diagnosis. Due to its conceptual coherence, basic science was more memorable and helped students to reconstruct the features of individual disease categories after the initial symptom lists had been forgotten (16).

The field of clinical management is a good example of the importance of basic knowledge. In that field, increased knowledge of basic sciences led to the progressive understanding of the pathophysiological mechanisms (7).

Medical schools must have an internal quality control...
system so that there is a very objective committee to evaluate and set forth educational standards expected to be attained by its students. As it has been discussed, written, and rewritten about the ultimate criteria, the educational effectiveness is correlated with instruction given, and is associated with quality and care that will eventually be rendered to patients. Bligh (22) concluded that the basic medical subjects taught to students do not focus on correlation with clinical learning.

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