Combination of didactic lectures and review sessions in endocrinology leads to improvement in student performance as measured by assessments

Ayisha Qureshi,1 Cassy Cozine,2 and Farwa Rizvi3

1Department of Physiology, Rawal Institute of Health Sciences, Islamabad, Pakistan; 2Department of Biology, University of Saint Mary, Leavenworth, Kansas; and 3Department of Community Medicine, Islamabad Medical and Dental College, Islamabad, Pakistan

Submitted 9 May 2012; accepted in final form 5 December 2012

Qureshi A, Cozine C, Rizvi F. Combination of didactic lectures and review sessions in endocrinology leads to improvement in student performance as measured by assessments. Adv Physiol Educ 37: 89–92, 2013; doi:10.1152/advan.00068.2012.—There can be no single best way of learning, and each teaching mode has its own merits and demerits. Didactic lectures in and of themselves are insufficient, whereas a problem-based tutorial alone can be as ineffective. This study was conducted to determine if a problem-based review after didactic lectures would lead to better student performance. To compare performance, the same student group was taught three units of endocrinology (growth hormone, thyroid hormone, and diabetes). Students were divided into the following three groups: diabetes didactic lectures only, growth hormone didactic lectures plus review, and thyroid hormone didactic lectures plus review. All three topics were covered in the didactic lectures, but only growth hormone and thyroid hormone topics were covered in the review session. At the end of the course, all students were given formative assessments in the form of multiple-choice questions. A highly significant increase (P < 0.001) in the percentage of correct responses on the questions covering growth hormone (mean: 0.838, SD: 0.158) and thyroid hormone (mean: 0.686, SD: 0.232) compared with diabetes (mean: 0.478, SD: 0.259) was observed. In conclusion, this study provides further evidence that the combination of didactic lectures and an active review session leads to an improvement in student performance.

endocrinology; review session; didactic lectures; assessments

HUMAN ANATOMY AND PHYSIOLOGY is undoubtedly a content-rich systematic course of study (5). Despite the knowledge explosion, many of us continue to teach the way we always have: “covering the content” (9). Covering the content without providing an opportunity to use, link, or apply it is of little educational value for current and future physiologists (13). As Mestrius Plutarch (45–125 AD), a priest of the temple of Apollo at Delphi, said: “A mind is a fire to be kindled, not a vessel to be filled,” because filling the mind does not work. This is important because active processing of information, not just passive reception of the information, leads to learning (9). That is, we understand the information we think about because understanding is the residue of thinking (35).

Physiology is a difficult subject for many medical students, in part because mastery of the discipline requires not only learning (i.e., memorizing) a large number of new terms, facts, and concepts but also considerable problem-solving ability. As teachers, we do a better job of teaching the facts of physiology than we do teaching problem solving (19). Thus, we must think about the idea that “how we teach is much more important than what we teach” (10).

There can be no single best way of learning, and, of course, each teaching mode has its own merits and demerits. Didactic lectures have had their fair share of criticism and have long been labeled as ineffective, despite the fact that lecturing facilitates the sharing of information with a large number of students and the fact that it may be effective in transmitting factual information (14, 18, 30). Lectures remain valuable for their efficiency and ability to give students an overview of a particular area of study. In addition, due to time restraints, not to mention limited resources, including room availability and instructor availability, it is impossible to completely exclude didactic lectures (29). However, they are too teacher centered, with less participation from students (26, 31). Studies have suggested that students do not learn by simply sitting in a classroom listening to the teacher (4). Students who are actively involved in learning retain information longer than when they are passive recipients of instructions (7).

The approach we took was based on the belief that it is important to relate what is unknown to what is known and placing the material into context (17, 22). This is critical because one of the most important factors influencing learning is what the student already knows. The student must consciously and explicitly link new information to concepts they already know. In this way, existing concepts are identified and new linkages are formed between concepts (9).

We used a combination of didactic lectures and a case-based review session to facilitate student learning with the objective of testing the hypothesis that it leads to an improvement in student performance as measured by assessments.

MATERIALS AND METHODS

This study was conducted with a class of 25 undergraduate students enrolled in the Anatomy and Physiology course at the University of Saint Mary (Leavenworth, KS). The content area was endocrinology. All students were taught endocrinology in a didactic fashion by a single lecturer. Having a single lecturer for the course was advantageous as there was time for the students to become familiar with the lecture approach and there are opportunities for continuity between lectures and for reinforcing important concepts throughout the lectures (33).

The entire class attended the 6-h endocrinology block, which consisted of didactic lectures spread over 2 wk. Each lecture spanned 60 min.

Toward the end of the 6-h block, for two (02) subsections of the course dealing with thyroid hormone (TH) and growth hormone (GH), students were provided additional case studies to consolidate their learning. The case studies were in the form of scenarios taken from the case collection available at the following website: http://sciencecases.lib.buffalo.edu/cs/collection/.
The cases were given as homework, and students were instructed to answer the questions after a review of the topic and bring their written answers to the review session. Students solved the case studies outside of the regular class. Student interactions and extensive brainstorming outside the class were encouraged.

The entire class underwent the review session. The review session, which was labeled as a tutorial, was part of the regular teaching module.

At the end of the course, students were tested on the information they had accrued in the course using multiple-choice questions.

The student group was kept the same so that no student would feel excluded and the entire class would be taught the same topics in the same manner and at the same time. Therefore, once the entire module of endocrinology had been taught in the didactic lectures, we decided to cover at least two of the three major topics in the review session. GH and TH were discussed in the tutorial, whereas insulin (diabetes) was not discussed (Fig. 1). (In summary, all three topics, GH, TH, and diabetes, were covered during the didactic lectures, but only GH and TH were discussed in the review session.)

Students were divided into the following three groups:
- Diabetes didactic lectures only: insulin (diabetes) was taught by didactic lectures only.
- TH didactic lectures plus review session: TH was taught by didactic lectures and review session.
- GH didactic lectures plus review session: GH was taught by didactic lectures and review session.

Review session labeled as a tutorial (small group discussion). Once the tutorial started, the pattern was as follows: one of the students was asked to read the questions aloud. The questions were put forward to the students, and, initially, for \(-15\) min, the teacher did not intervene at all. Once a discussion was underway, the teacher intervened when and as required. A PowerPoint slide show was also ready, which was projected, when and where required, to clarify concepts. Questions were put forward by the teacher that kept the students on track and ensured that no important point was missed. This process not only encouraged critical thinking and problem solving in students but also provided a way for the teacher and the students themselves to assess the level of their understanding.

Student participation was voluntary; students were verbally stimulated to participate, but they did not receive any bonus for participation or punishment if they did not. Students were observed listening, providing constructive feedback, and reflecting on their learning.

In conclusion, the teacher summarized the lesson and validated the learning that occurred. She reviewed certain concepts that she felt needed clarification and/or reinforcement and then wrapped up the topic, intentionally highlighting particularly important points.

There were no added costs for the implementation of the activities; there was no requirement for extra rooms or additional instructors.

After the in-class review of the cases had been completed, an additional 15 min were provided to the students to make additions to their answers, which were then submitted.

The submitted answers were checked but not marked for formative assessments and returned by the end of the week to ensure that the students had them when they studied for the assessments.

Assessments. The class underwent a single uniform assessment in the form of a quiz, which was composed of multiple-choice questions. The result of the quiz was used to compare class performance.

Statistical analysis. All results are presented as mean scores with SDs. To determine the effect of the review session on student performance on the multiple-choice questions (mastery of the original material), we used one-way ANOVA to compare the scores obtained on questions on diabetes, GH, and TH in the quiz.

As multiple comparisons were being made, a Bonferroni correction was done post hoc. Statistical significance was established as \( P < 0.05 \).

RESULTS

Students underwent a single objective test in the form of multiple-choice questions at the end of the course. Student performance was evaluated by the number of correct responses given for the questions under each topic of the endocrinological unit.

One-way ANOVA showed the dependence between the review session and student performance as measured by assessments (Table 1). We observed a highly significant increase \(( P < 0.000 )\) in the percentage of correct responses on the questions covering GH (mean: 0.838, SD: 0.158) and TH (mean: 0.686, SD: 0.232) compared with diabetes (mean: 0.478, SD: 0.259). As multiple comparisons were being made, a Bonferroni correction was applied post hoc. Significant results were observed (Table 2). The imprecision suggested by the poor performance of the students on questions covering diabetes suggests that there were many concepts that needed to be clarified and that the misconceptions that were encountered by the students were persistent and repetitive.

On the other hand, the significantly improved performance by the same students on questions related to TH and GH...
and at the beginning of the course,

**Table 2. Summary statistics of multiple comparisons between groups after Bonferroni post hoc correction**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of Students/Group</th>
<th>Mean Difference</th>
<th>SD</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes didactic lectures only</td>
<td>25</td>
<td>0.478</td>
<td>0.259</td>
<td>0.000*</td>
</tr>
<tr>
<td>Thyroid hormone didactic lectures plus review session</td>
<td>25</td>
<td>0.686</td>
<td>0.232</td>
<td></td>
</tr>
<tr>
<td>Growth hormone didactic lectures plus review session</td>
<td>25</td>
<td>0.838</td>
<td>0.158</td>
<td></td>
</tr>
</tbody>
</table>

The diabetes endocrinological unit was taught by didactic lectures only. The thyroid hormone and growth hormone endocrinological units were taught by didactic lectures and a review session. *P value was highly significant (0.000).

indicates the high degree of understanding students had for these topics.

**DISCUSSION**

Didactic lectures in and of themselves are insufficient, whereas problem-based learning alone can be as ineffective (32). With this thought in mind, we designed this study using the hypothesis that after a topic had been covered in didactic lectures and students had been given enough time to “grapple” with the information followed by a problem-based review session during regular teaching hours and before the final assessments, better student performance would be observed on the assessments. The results indicated that when didactic lectures are followed up by a comprehensive problem-based review session, student performance improves, as observed by the increased percentage of correct answers for topics taught by both didactic lectures and a review tutorial session compared with the low percentage of correct answers for topics taught by didactic lectures only.

As can be seen, there are three very clear components to our hypothesis: 1) the content must be covered in the bulk lectures and at the beginning of the course, 2) the cases must be given in the form of problem-based case scenarios and time must be given to the students to work through them, and 3) the active review session must be conducted during regular teaching hours and before the final assessment.

**Didactic lectures.** For our study, we scheduled the didactic lectures at the beginning of the course block. This is because at the beginning of any course, students find adopting a self-directed problem-based approach to learning difficult as they “do not know what they do not know.” Giving them a problem-based case in the very beginning without a comprehensive review of the concepts and facts will leave them confused, as students may have restricted personal knowledge of the complexity of the case (3, 28). The same observation was made by West (34): that the use of formal lectures followed by extensive discussion groups is a good compromise and format.

**Use of case histories as case scenarios.** The effectiveness of using case histories as case scenarios finds basis in the fact that there is a limit as to how much can be learned about the human system when it is in equilibrium, i.e., when it is healthy and unperturbed. Once it is perturbed, however, much can be discovered about its inner nature by observing how the disturbance spreads through the system. Thus, it is the disturbance induced by disease that reveals physiological features normally unnoticed or invisible (12).

However, collecting cases is the most time-consuming part of the process (33). A well-written case/problem can stimulate interest or trigger a discussion, depending how you use it. We used the problems as triggers: as a way to stimulate the students into thinking, into questioning. Usually questions were returned with more questions by the teacher because oral questioning with informal responses encourages more participation and a sustained attention span (16).

**Active learning.** Small group discussions in physiology accomplish several things: they improve communication skills (25), promote deeper understanding of the subject among the students, and facilitate the discussion of physiological concepts among undergraduates, thereby leading to critical thinking in students.

Case studies were provided to the students a few days in advance so that they could be studied and reviewed. This also ensured that the students reviewed the text related to the topic.

Once the discussion started, it was observed that without the fear of being penalized by grades, students could freely express their understanding about physiological mechanisms. A previous study (15) has shown that when students express ideas using their own words, the learning process occurs. So the bit of translation work you do in converting information into your own words is an important step in the “encoding” process, the process whereby your brain gradually converts new information into a lasting memory. Students must have time to grapple with specific information relevant to the topic (6). This entire process leads to the

**Table 2. Summary statistics of multiple comparisons between groups after Bonferroni post hoc correction**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean Difference</th>
<th>SD</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes didactic lectures only</td>
<td>−0.209*</td>
<td>0.062</td>
<td>0.004*</td>
</tr>
<tr>
<td>Thyroid hormone didactic lectures plus review session</td>
<td>−0.361*</td>
<td>0.062</td>
<td>0.000*</td>
</tr>
<tr>
<td>Growth hormone didactic lectures plus review session</td>
<td>0.209*</td>
<td>0.062</td>
<td>0.004*</td>
</tr>
<tr>
<td>Thyroid hormone didactic lectures plus review session</td>
<td>−0.152</td>
<td>0.062</td>
<td>0.052</td>
</tr>
<tr>
<td>Diabetes didactic lectures only</td>
<td>0.093</td>
<td>0.062</td>
<td></td>
</tr>
<tr>
<td>Growth hormone didactic lectures plus review session</td>
<td>0.152</td>
<td>0.062</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*Mean difference was significant at the 0.05 level (P < 0.05).
formation of new neuroassociations, which ensure lasting memory by reinforcing key facts repeatedly (15).

Thus, students who are actively involved in the learning process will learn more than students who are passive recipients of knowledge (2, 8) because active involvement enhances the student’s level of understanding and ability to integrate and synthesize material (1, 11, 23, 24, 27). This result is in agreement with that of Michael et al. (20), who concluded that many students memorize facts but do not develop a deeper understanding of how physiological phenomena occur, which reinforces that learning and memorization are not the same (21).

Placing the review session before final assessments. It is interesting to note that students are very keen to discuss tricky and difficult questions during a review session that has been scheduled before the final assessments, as observed by Favero (13). We made the same observation. Not only are students less stressed and more open to learning new concepts and clarifying old ones, but they are also more open to learning something about themselves as learners. When students are then asked to complete the answers to the case study after the review and submit them, it helps strengthen a teachers’ position that she is indeed on their side. The answers are corrected and returned before the exams so that the students have these with them when preparing for the study exams. What is the use of revealing the correct answers to them after the exams with the lingering concern of the impending grades looming over them? It is just water under the bridge then.

The significant increase in the percentage of correct answers for the topics covered by the combination of didactic lectures and review session indicates that this is indeed beneficial for the students. We also believe that the planned sequence of the teaching modalities with the review session after the didactic lectures with intentional time spared in between for the student to grapple with information only added to the advantages.

Limitations. This study has methodological limitations that must be kept in mind when the results are interpreted. First and foremost, the sample group was far too small. A larger student group (at least 33 students) would have been more effective. Also, a proforma documenting the students’ feedback would provide a better understanding of the students’ perspective regarding the same hypothesis.

Conclusions. Didactic lectures in and of themselves are insufficient, whereas a problem-based tutorial alone can be as ineffective (32). Our study indicates that a combination of both didactic lectures followed by a problem-based review session leads to a significantly better performance by students, as measured by their assessments.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: A.Q. and C.C. conception and design of research; A.Q., drafted manuscript; A.Q., C.C., and F.R. edited and revised manuscript; A.Q. and C.C. approved final version of manuscript; F.R. analyzed data; F.R. interpreted results of experiments.

REFERENCES