Combination of didactic lectures and case-oriented problem-solving tutorials toward better learning: perceptions of students from a conventional medical curriculum

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Ghosh S. Combination of didactic lectures and case-oriented problem-solving tutorials toward better learning: perceptions of students from a conventional medical curriculum. Adv Physiol Educ 31: 193–197, 2007; doi:10.1152/advan.00040.2006.—The Department of Physiology of Pramukhswami Medical College at Anand, Gujarat, India, started using problem-based learning in a modified way along with didactic lectures to improve students’ understanding and motivate them toward self-directed study. After the didactic lectures were taken for a particular system, clearly defined short clinical problems related to that system were given to the students in the tutorial classes. Each tutor was assigned three to four groups of five to six students each. Problems were accompanied with relevant questions so as to streamline the thought processes of the first-year undergraduates. The tutor then facilitated the study process, and the students discussed among themselves to derive their solutions. At the end of the sessions, feedback was taken from the students through a planned questionnaire on a three-point scale. Of a total of 278 students over a span of 3 yr from 1999 to 2002, 74.4% of students favored a judicious mixture of didactic lectures and case-oriented problem solving in tutorial classes to be an efficient modality in understanding a system under study, and 84% of students stated the mixture of didactic lectures and case-oriented problem solving to be beneficial in relating a clinical condition to the basic mechanism; 82% of students believed that this module helped with better interactions among their batch mates, and 77.2% of students hoped to perform better in the university examination due to this new teaching/learning modality. They also expressed that this gave them ample motivation to do self-directed learning. It may therefore be concluded from the results of the present study that it is possible to have a problem-based learning module in the form of case-oriented problem-solving tutorials coexistent with the traditional didactic lecture module in the first year of medical education under a conventional curriculum.

problem-based learning

Physiology is one of the foundation sciences for the medical curriculum and needs to be taught and learned effectively so as to be placed in the context of disease when the medical students graduate and practice in the community. In the traditional/conventional system of medical education, it is taught in the first year of a 4.5-yr medical course, along with anatomy and biochemistry, with least interdisciplinary interaction. In most of the medical schools of India, it is mainly taught by means of didactic lectures, tutorials, and practical classes. Such a system is teacher centered with minimal active participation from the students. Medical practice is essentially a problem-solving activity whether at individual, family, or community levels (5). The emerging trend all over the world is to have a problem-based, integrated student-centered medical curriculum, demanding active participation from the students and facilitating self-directed learning. Problem-based learning (PBL) was first introduced by the McMaster University Medical School as an educational format centered around the discussion and learning that emanates from a clinically based problem. It encourages independent learning and deeper understanding of a particular topic. However, this has some disadvantages, the most important of which is the tendency of students to jump to diagnostic conclusions and go through medicine textbooks to find out the treatment protocol for the disorder. Despite the disadvantages, PBL has been widely accepted as a module for medical education by most of the medical colleges around the globe, and many have eventually switched over to a PBL curriculum from the traditional curriculum. The Medical Council of India, in its recent recommendations for Graduate Medical Education in 1997, implied the introduction of PBL/teaching in basic medical subjects like physiology, but the curriculum has been maintained to be that of the traditional type (7).

It is well known that no system could be full proof in its application; it must be modified and applied to suit the needs of a particular batch of students in a particular infrastructure. Some of the conventional schools in India have incorporated components of PBL in their existing conventional curriculum (4).

Pramukhswami Medical College at Anand, Gujarat, India, is one of the 160 medical colleges of India that follows a curriculum and teaching modules centrally determined by the Medical Council of India. Here, the curriculum followed is that of the traditional type, where physiology is taught with anatomy and biochemistry during the first year of the 4.5-yr medical course. The Department of Physiology aimed to introduce PBL modules in their teaching program in a modified form while retaining some didactic lectures. Implementation of PBL in its original format using a problem to initiate learning and identifying the learning objectives was not possible because of the following reasons:

1. Most of the faculty in the department were unaware of the modes of PBL since they themselves were subjected to teacher-centered passive education.

2. Admission criteria were on the basis of merit in the High School Board Examination and not on the specific competitive Medical Entrance Test.

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3. Students with an entry age of a tender 17–18 yr had no experience of self-directed learning in school days and thus needed some amount of formal teaching.

4. There was a lack of infrastructure, a high student-to-teacher ratio, and insufficient library and internet facilities.

5. The vernacular medium of education for most students in the school and high school caused difficulty in understanding English compositions presented in the problems.

6. Finally, there was resistance from some elderly, experienced faculty of the department who did not favor self-directed learning by students, probably due to a fear of losing their importance and identity.

With all these challenges in the way, a new modified version of PBL as a case-oriented problem-solving tutorial (COPST) educative protocol was introduced. Care was taken regarding all of the above-mentioned points, and this new learning strategy was introduced along with the didactic lecture classes. The protocol was introduced in the tutorial classes with smaller groups of students, and the methodology was modified to suit the environment of education in the present setting. A learning format was designed that would give the students an interesting approach to study, not deviating much from the regular didactic lecture classes, giving them a formal approach to the course that was new to them.

The aim of the present exercise was to introduce the students to an alternative method of learning compared with the traditional one used, to encourage them to work as a team, to assess the students’ acceptance of this modified teaching module, to highlight the success of the said modification for 3 consecutive years, and to indicate the importance of a judicious mixture of didactic lectures and PBL sessions in training medical undergraduates in their basic sciences under the conventional curriculum.

**METHODS**

The study was performed on first-year medical undergraduates of the Pramukhswami Medical College from 1999 to 2002 for three consecutive batches (1999–2000, 2000–2001, and 2001–2002), with intake in each year being 100 students. Since admission criteria in the state of Gujarat are on the basis of a high school board examination, students were mostly of 17–18 yr of age. Students were of mixed academic and socioeconomic backgrounds coming from English medium as well as vernacular medium of school education.

The teaching module was composed of mainly didactic lectures, tutorials, and practical or demonstration classes based on a nicely formatted time table. Six lecture classes and two tutorial classes per week were scheduled. The case-based problem-solving learning module was introduced during the tutorial classes.

Because of the large class size, we had to divide the group into two halves of 50 students each. Tutorials were held twice a week, and, each day, a batch of 50 students came to the class. In the initial class, they were first given an introduction to the technique with merits and demerits of alternative learning modules with an overview how to use the library and internet and how to think analytically. During the class, they were subdivided into three smaller batches of ~16–17 students each with 1 tutor supervising the group. The tutor then further subdivided them into three smaller batches of about five to six students each. Thus, with three tutors the whole exercise could be performed quite smoothly. There were absentees, of course, but they were not regular absentees, so at some time or other they underwent the same training.

Each batch was given a clinical problem in which the symptoms of a particular disorder of a system were made very clear and a set of questions was given following the problem. This was done to ensure that students who had just entered the medical school thought in an organized fashion based on the knowledge that they gathered in the lecture class. The cases were presented to the students on the departmental notice board or sometimes in the open lecture class 1 day earlier to the tutorial.

Care was also taken regarding the following:

1. The case/problem was brief and correctly formulated and framed in such a way that they matched the students’ level of previously acquired knowledge, that is, the system must have been covered in the didactic lecture classes (4).

2. Questions were discussed properly and systematically.

3. Each member of the group had a chance to participate.

4. Students did not attempt to jump to conclusions and find a diagnosis of the disease.

*Appendix I* gives an example of a problem used in the said exercise.

Students were given sufficient time to discuss among themselves, following basic text books of physiology. The tutor remained present throughout the exercise for each batch of 16 students. Tutors had been previously trained regarding the principles of PBL and its objectives. They learned the basic skills of small group teaching and remained as a facilitator, not as an instructor. They remained just to streamline the thought processes of the students by discussing the answers to which the students had arrived and clarifying any doubt or controversy during the discussion (11). The total time for supervision was 40 min, and 20 min was the wrap-up discussion presented by each group.

Although care was taken to involve every student, some students possibly hid deliberately from the exercise or avoided it because of their lack of knowledge in English, but they constituted a very small fraction of every batch, and their comments in the end was “no idea.”

Throughout the year, during the tutorial classes, this mode of teaching/learning process was continued in parallel along with didactic classes. At the end of the term, students were given a questionnaire to put forward their opinions regarding the usefulness of the technique.

*The questionnaire.* Twelve questions with a response scale of 3 points were framed in such a way that yielded information regarding the following:

1. The usefulness of didactic lectures and PBL in physiology tutorial classes and a judicious mixture of both in the context of understanding the systems students were studying;

2. The relevance of PBL in physiology tutorial classes and didactic lecture plus PBL in tutorials in the context of relating the clinical condition to the basic mechanism;

3. Whether there had been a valuable exchange of ideas in small-group discussions in the tutorial classes and whether this would improve the students’ performance in the university examination.

A sample of the questionnaire along with the responses asked for is included in *Appendix II.*

**RESULTS**

As shown in Table 1, 82% of the students rated the case-based tutorials as either very useful or useful, whereas only 11% of students rated the case-based tutorials as not useful.
Table 1. Usefulness of didactic lectures and PBL as well as the judicious mixture of both in physiology tutorial classes in the context of understanding the systems being studied

<table>
<thead>
<tr>
<th>Didactic lectures only</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>12</td>
<td>57</td>
<td>63.3</td>
<td>20 (22.2)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>10</td>
<td>60</td>
<td>64.5</td>
<td>20 (21.5)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>15</td>
<td>65</td>
<td>68.2</td>
<td>15 (15.7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PBL sessions only</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>41</td>
<td>32</td>
<td>35.5</td>
<td>10 (11.1)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>43</td>
<td>37</td>
<td>39.7</td>
<td>6 (6.45)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>45</td>
<td>30</td>
<td>31.5</td>
<td>15 (15.75)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Didactic lectures + PBL</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>47</td>
<td>13</td>
<td>14.4</td>
<td>28 (31.1)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>47</td>
<td>20</td>
<td>21.5</td>
<td>24 (25.8)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>45</td>
<td>35</td>
<td>36.7</td>
<td>15 (15.75)</td>
</tr>
</tbody>
</table>

Data are absolute values with percentages in parentheses; there were 90 responses elicited in 1999–2000, 93 responses elicited in 2000–2001, and 95 responses elicited in 2001–2002, with a batch size at admission of 100 students/yr.

Table 3. Responses of students as to whether they had a valuable exchange of ideas in the small-group discussions in the tutorial classes and whether they thought that this would improve their performance in the university examination

<table>
<thead>
<tr>
<th>Exchange of ideas</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>45</td>
<td>10</td>
<td>11.1</td>
<td>34 (37.74)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>54</td>
<td>19</td>
<td>20.42</td>
<td>18 (19.35)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>54</td>
<td>18</td>
<td>18.9</td>
<td>23 (24.15)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Better performance in the university examination</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>45</td>
<td>16</td>
<td>17.8</td>
<td>29 (32.2)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>50</td>
<td>20</td>
<td>21.5</td>
<td>20 (21.5)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>45</td>
<td>15</td>
<td>15.7</td>
<td>25 (26.2)</td>
</tr>
</tbody>
</table>

Data are absolute values with percentages in parentheses; there were 90 responses elicited in 1999–2000, 93 responses elicited in 2000–2001, and 95 responses elicited in 2001–2002, with a batch size at admission of 100 students/yr.

compared with didactic lectures only; 79% of students rated only didactic lectures as either very useful or useful, whereas 19% of students rated didactic lectures as not useful. The marked observation was that 46.4% of students rated COPST as very useful and thus considered it a better option in relation to didactic lectures, which only 13% of students rated to be very useful. A mixture of didactic lectures plus COPST was rated to be either very useful or useful by 74.5% of students, of which 50% of students rated it to be very useful. This is again in marked contrast with the 13% of students favoring only didactic lectures as very useful. Only 24% of students stated it to be not useful, which was insignificant. This showed that the students accepted this new form of the teaching/learning module along with conventional didactic lectures and opined that this combination was useful in understanding the systems they were learning in physiology.

As shown in Table 2, 88% of students favored COPST as a better mode helping them to relate clinical conditions to the basic mechanism toward a better understanding of concepts. Only 6% of students opined negatively. When queried regarding the combination of didactic lectures plus COPST, again, 84% of students favored the module, whereas 10% of students stated that it did not have any relevance in the context in relating clinical science with basic science.

As shown in Table 3, 82% of the respondents stated that the protocol of COPST helped them to have a better and valuable exchange of ideas among fellow students and 77% of students hoped that this would help them to score better in the first professional university examination.

Table 4 shows a consolidated view of all the respondents with reference to the usefulness of COPST as well as didactic lectures plus COPST in the better understanding and better correlation of basic and clinical sciences and the useful exchange of ideas in groups.

DISCUSSION

There has been always a question in whether a problem-based tutorial form of teaching could be conducted in basic science departments. Faculty members have expressed doubts about the wisdom, effectiveness, and educational efficacy of such a format to teaching the sciences basic to medicine (12). Many different types of small-group learning activities are labeled PBL, with classic PBL being defined as the method originally described by Barrows et al. (2). The key characteristics of PBL include active participation by the students, the development of problem-solving skills rather than memorization.

Table 2. Relevance of PBL as well as didactic lectures plus PBL in physiology tutorial classes in the context of relating the clinical condition to the basic mechanism

<table>
<thead>
<tr>
<th>Didactic lectures + PBL</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–2000</td>
<td>54</td>
<td>8</td>
<td>8.88</td>
<td>25 (27.7)</td>
</tr>
<tr>
<td>2000–2001</td>
<td>50</td>
<td>10</td>
<td>10.7</td>
<td>25 (26.8)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>60</td>
<td>10</td>
<td>10.5</td>
<td>20 (21)</td>
</tr>
</tbody>
</table>

Data are absolute values with percentages in parentheses; there were 90 responses elicited in 1999–2000, 93 responses elicited in 2000–2001, and 95 responses elicited in 2001–2002, with a batch size at admission of 100 students/yr.

Table 4. Consolidated responses of all the students regarding the utility of didactic lectures plus COPST toward a better understanding of physiology principles

<table>
<thead>
<tr>
<th>Didactic lectures + COPST</th>
<th>Yes</th>
<th>No</th>
<th>To Some Extent</th>
<th>No/Not Very Useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didactic lectures</td>
<td>13</td>
<td>65.5</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>COPST</td>
<td>46.4</td>
<td>35.6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Didactic lectures + COPST</td>
<td>50.0</td>
<td>24.4</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

Data are percentages of students; n = 278 students total.
How We Teach

PERCEPTIONS OF STUDENTS TOWARD DIDACTIC LECTURES AND COPST

...tion, and learning to learn in a collaborative group-centered environment. Case studies have also been proposed to promote active learning (8). The present study used a case-oriented format to promote inquiry-driven learning in first-year medical undergraduates. Of a total of 278 students over a span of 3 yr from 1999 to 2002, the percentage of students favoring a judicious mixture of didactic lectures and case-oriented problem-solving sessions in tutorial classes was 74%, which suggested that this format was well accepted by first-year medical undergraduates despite the vernacular basis of earlier education. Hence, the present study shows that it is possible to introduce a modified version of PBL into a traditional curriculum with a formal lecture-based program. The didactic lectures followed by a case on a specific clinical problem to be discussed in the tutorial class by the students under the supervision by the tutor facilitator created interest among the students, who were otherwise conversant with didactic lecture classes, which are basically teacher centered. Rapid and extensive proliferation of PBL instructional methodology and its application in various basic science disciplines have been well accepted by medical teachers, and many institutions have switched over to a PBL curriculum from a conventional type (1). Experiments by medical teachers have shown that it is possible to introduce a problem-based form of learning into a new course in parallel with more traditional modes of teaching, making it successful to some extent for students who are used to a didactic form of curriculum (9). Neube and Clark (10) also showed that it was possible to introduce changes in teaching format under the traditional curriculum with the advantage of reducing didactic teaching and workload and improving self-directed learning skills in students. A recent study by Bhattacharya et al. (3) put forward the view that even in a conventional curriculum, PBL can be introduced in small modules subjectwise despite limited resources, rigid time schedules, and fewer interdepartmental interactions. A study (6) has also shown that most Asian medical schools and their students appear to be positive about adapting PBL into their curriculum. Our students also reflected the same. Successful implementation of PBL requires the cooperation of students and teachers along with the strong administrative regulatory body.

Learning needs to be an active constructive mental activity; as the popular saying goes, to make someone understand a particular area of knowledge, it is best to involve them. This modified version of PBL served the said purpose in giving a case and allowing students to handle it analytically.

There was close to complete participation from the students without deviating much from the traditional teaching programming; 55% of students believed that this module helped with better interactions among their batch mates and gave them ample motivation to do self-directed learning. It boosted their learning skills. With this didactic lecture plus PBL format, students could generate learning issues based on preexisting knowledge of the same. It was not difficult for them to understand basic physiological processes and explain the clinical observations based on the basic principles. The questions that accompanied the problems helped them to streamline the discussion and reach a satisfactory explanation.

Each problem served as a springboard to learning and did not force the students to make a quick diagnosis and work out management plans. The primary objective was to help first-year medical undergraduates understand a basic physiological principle and to be able to correlate this in the context of a clinical setting. Although it is difficult to conceive of PBL on a subject basis, under the prevailing circumstances in our medical college, it was undertaken with slight modifications that ultimately motivated our students not only toward a self-directed learning and understanding of physiological principles but also toward the development and maintenance of their personal characteristics: personal assets, limitations, emotional reactions, responsibility, dependability, and an evaluation of personal and group progress. It enabled the students to perform concept mapping through the asking of questions and sharing of information.

This was an initial attempt to familiarize the students in the first year of their medical school with newer alternative methods of learning compared with traditional teacher-centered didactic lectures and to encourage them to work as part of a team. This attempt showed that it was possible to introduce a problem-based form of learning into a conventional medical curriculum in parallel with the traditional modes of teaching.

It may be concluded from the results of the present study that it is possible to have a modified PBL module (COPST) co-existant with the traditional didactic lecture module under a conventional curriculum. It is well appreciated by the students since it improves their self-directed learning skills and their ability to relate basic physiological principles to a clinical setting, which they are expected to do in their later years of medical schooling. There can be no single best way of learning, and, of course, each teaching mode has its own merits and demerits. Lectures remain valuable for their efficiency and in giving the students an overview of a particular area of study. On the other hand, it is too teacher centered, with less participation from the students. Case-oriented problem-solving learning is effective in encouraging students to take charge of their own learning, define learning objectives by themselves, and learn to work in a group. A judicious mixture of both didactic lectures and case-oriented problem-solving learning modules may be helpful in coaching the medical undergraduates in their first year of training, making them able to undertake self-directed learning, learn group dynamics, and develop the skills of correlating basic science with clinical science in the later years of their training.

All the students of these batches have passed their final professional exam, and 75% of the students of the first two batches are either doing postgraduation work or preparing for admission tests, whereas the last batch has recently passed out and is doing internships.

APPENDIX I

AB, a 14-yr-old female, was in good neurological health until recently. Thereafter, she began to have difficulty with speaking, swallowing, and vision and experienced weakness in her arms. Her difficulty with speaking used to occur late in the day, generally just before bedtime. This progressed over a period of about 10 days, and, day by day, difficulties started appearing earlier in the daytime until it was a persistent problem. She also continued to have vision disturbances, and, in the evening, her eyelids used to droop (ptosis) and she had...
to arch her head backward to watch television. She also noted that she had difficulty with her arms, particularly after moving them for any length of time. Later on, she also faced difficulty with smiling, spitting, and sucking. There was no family history of similar difficulties, and the patient had no history of any other neurological or immunological disorders. Mental state, motor systems, sensory systems, cerebellar functions, and reflexes were all found to be normal. The patient was injected with an anti-cholinesterase drug. Her strength dramatically improved within few seconds of the injection. However, weakness returned about 5 min later. Gradually, the disease progressed, and the patient was put on a long-acting anti-cholinesterase drug and her situation improved.

Discuss the case with reference to the following questions:
1. What is the case? Justify your statement.
2. What is the probable cause of the muscular weakness?
3. Explain the situation in a normal individual.
4. How will the electromyograph recordings vary between this patient and a normal one?
5. What was the rationale of using the anti-cholinesterase drug?

APPENDIX II: QUESTIONNAIRE
1. In understanding a particular topic, didactic lectures were:
   A. Very useful.
   B. Useful.
   C. Not useful.
2. In understanding a particular topic, PBL sessions were:
   A. Very useful.
   B. Useful.
   C. Not useful.
3. The problems given in the physiology tutorial classes were in the context of the system currently studied.
   A. Yes.
   B. No.
   C. No idea.
4. In PBL sessions, a valuable exchange of ideas took place in group discussions.
   A. Yes.
   B. No.
   C. To some extent.
5. In physiology tutorial classes, a valuable exchange of ideas took place in group discussions.
   A. Yes.
   B. No.
   C. To some extent.
6. During PBL sessions, tutor guidance was:
   A. Not required.
   B. Helpful.
   C. Not helpful.
7. During your tutorial, tutor guidance was:
   A. Adequate
   B. Not adequate.
   C. Adequate to some extent.

8. By virtue of PBL sessions, clinical conditions could be better related to basic mechanisms.
   A. Yes.
   B. No.
   C. To some extent.
9. By virtue of the problem-based physiology tutorial classes, understanding of the subject/topic was better.
   A. Yes.
   B. No.
   C. To some extent.
10. All PBL sessions should be preceded by didactic lectures on the system to help with better understanding.
    A. Yes.
    B. No.
    C. To some extent.
11. Do you think that training in the PBL sessions will help you in preparing you for the final university examination?
    A. Yes.
    B. No.
    C. To some extent.
12. Do you feel that there should be a judicious mixture of didactic lectures and PBL sessions for a better understanding of a particular system and associated clinical conditions?
    A. Yes.
    B. No.
    C. To some extent.

ACKNOWLEDGMENTS

The author thanks the Head of the Department of Physiology at Pramukhswami Medical College for giving permission to perform this study, the tutors for assisting in implementing the module successfully, and the students without whose response and participation this article could not have been possible.

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